Volume 27 OCTOBER, 1920 Number 2

MACHINERY

THE INDUSTRIAL PRESS Publishers 140-148 LAFAYETTE ST., NEW YORK

VOLUME 27

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THE INDUSTRIAL PRESS, 140-148 LAFAYETTE ST., NEW YORK CITY

CONTENTS OF THIS NUMBER

Published monthly. Yearly subscription in United States and territories $3, plus $1 Zone postage west of Mississippi and in Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Cuba and Mexico; Canada, $4.50; foreign countries, $6; single copies, 35 cents, postage extra. A subscription is acknowledged by sending the current number. Checks and money orders should be made payable to THE INDUSTRIAL PRESS.

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Circulation for September, 1920, 26,750 Copies

Member Audit Bureau of Circulations

Entered as second-class mail matter, September, 1894, at the Post Office, in New York, N. Y., under the Act of March 3, 1879. It is understood that all contributed articles pertaining to machine shop practice and machine design are submitted exclusively to MACHINERY; when accepted and published, payment is made at our regular space rates unless other terms have been agreed upon.

FOREIGN MACHINERY MERCHANTS PAGES, 528-529—ADVERTISERS INDEX, 559-560—PRODUCT INDEX, 530-556.

The Editor's Talk With MACHINERY'S Readers

NO one will deny that the youngest of America's big industries is at the same time its most highly developed insofar as manufacturing methods are concerned. American manufacturers have always led the world in machine tools and machine shop methods; but no industry has put machine tools to such searching tests as the automobile industry—both as to productive capacity and ability to meet the severe requirements of highly accurate work. It is in the automobile plants that we find machine tools used in the most efficient manner, utilizing methods for producing accurate work at low cost without a parallel in any other metal-working industry. These highly efficient shop methods can be applied with equally good results in practically all other metal-working plants, with the necessary modifications in accordance with the quantity of production, the size of the product, and the requirements for accuracy.

IN this number of MACHINERY several phases of automobile shop practice are dealt with. The leading article, on Cadillac Grinding Practice, describes the methods used at the Cadillac plant. A careful reading of this interesting article will indicate to the man of mechanical experience, the refinement of manufacturing practice characteristic of the work in plants engaged in building high-grade motor cars. It shows the careful attention paid to details, and presents practical ideas which can be applied to advantage in hundreds of shops. The variety of grinding operations dealt with gives a comprehensive review of the methods used in one of America's leading automobile plants.

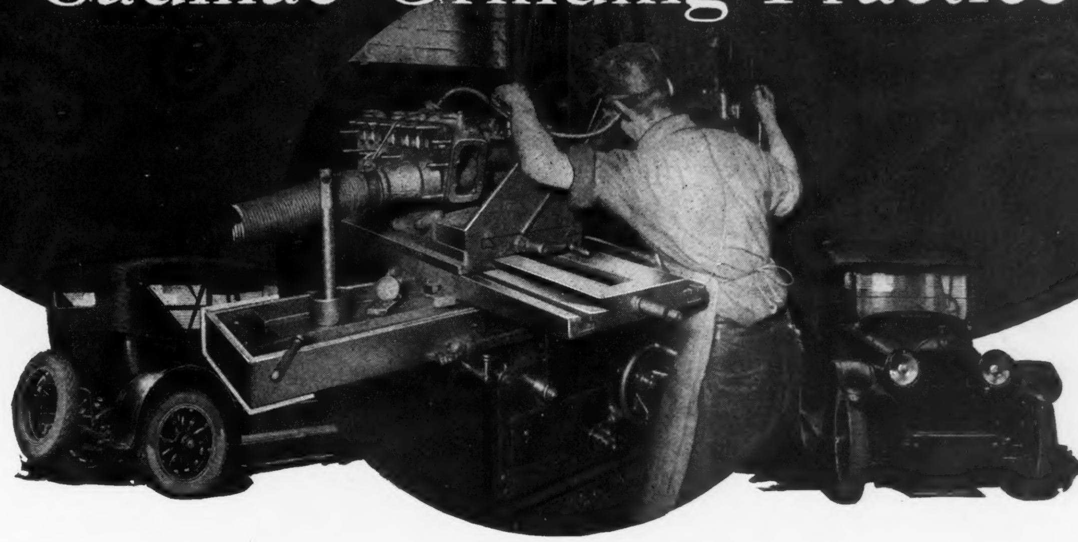
THIRTY years ago aluminum was practically an unknown metal in the machine-building field. Then, when commercial methods for producing aluminum had been developed, exaggerated ideas became prevalent as to its importance in the metal-working industries. There were engineers of considerable reputation who expressed the belief that aluminum would replace iron and steel for almost any purpose; yet, at that time, there was no definite idea of the possible field of usefulness of this metal. Today, however, aluminum has secured for itself an important and well defined place in the metal working industries; and while we do not now believe that it will replace steel for most purposes, it is recognized that aluminum will become more and more generally used for machine parts where lightness is of importance and where the great strength of steel in its manifold forms is not required. In automobile construction, especially, aluminum is becoming one of the most valuable materials.

THE methods of machining aluminum differ greatly from those used in machining steel or cast iron, because aluminum is so soft that speeds and feeds which would be impossible in working the harder metals, may be very successfully applied to this light material. The practice of the Hudson Motor Car Co., Detroit, in machining aluminum transmission cases and pistons may be considered the last word in work of this kind, and a complete review of this company's practice, showing operation lists and production rates is given in the article, Machining Aluminum Automobile Parts.

THERE are many other articles of equal interest, dealing with such varied subjects as Continuous vs. Station Milling, Turret Lathe Design, Special-purpose Machines in a Machine Tool Plant, Die Design for Drawing Difficult Shapes, Manufacturing for Selective Assembly, Machine Tool Counterweights, Continuous Production Drilling, Precision Measuring Devices, Drafting-Room Progress Record, Machining Clutch Parts on the Turret Lathe, the Manufacture of Automobile and Truck Axles. Then there are numerous Practical Letters from MACHINERY'S readers giving descriptions of new devices and shop methods, solutions of problems submitted to the How and Why columns, and that most complete review of New Machines and Tools brought out during the month. The New Tools department of MACHINERY would alone warrant the publication of a technical journal, so important is the service it renders.

THE earnest men and women—technical writers, editorial and advertising, artists and designers; the business people in many departments; the engravers, compositors and printers, and all the others engaged in the manifold useful tasks the sum of which is monthly MACHINERY, have great pride in the result, for they know it is as good as whole-hearted work and trained ability can make it, and above all others, they know it renders service.

Cadillac Grinding Practice



Description of Methods Employed in the Grinding Department of a Plant Building High-grade Automobiles

By EDWARD K. HAMMOND

THE average man is likely to base his estimate of the quality of a motor car by the size of the check which he has to draw in making payment for it. He knows that a machine built by one of the high-grade makers "rides" more easily and runs with less noise than an inexpensive car, but he would probably find considerable difficulty in giving an adequate explanation of the reasons for these pronounced differences in operation. If he had occasion to visit the plant engaged in manufacturing thousands of the light car which is seen on the city streets and country highways of every state in the union, and then compared these production methods with those employed in building one of the high-grade American machines, he might well be prompted to ask the question: "If those little four-cylinder cars can be produced under conditions where rapidity of output appears to be the controlling impulse of the whole organization, and still run satisfactorily when placed in service, is there not a lot of unnecessary refinement in the methods used in building the so-called 'luxury' machines?"

This question would probably call for both an affirmative and a negative reply, depending upon whether the function of a high-grade car is to provide service or luxury. From a purely utilitarian standpoint, it is obvious that a great deal of unnecessary work is done in holding the limits of tolerance on dimensions of all parts of the mechanism within extremely close margins; but although such work does not necessarily add to the amount of service obtained from the car during a reasonable operating life, it certainly is responsible for the easy riding properties and for the freedom from noise which place a car in the luxury class. Obviously it adds greatly to the cost of production to hold limits of a thousandth or a few ten thousandths of an inch on all important dimensions of a majority of parts of the mechanism, but as such a practice is one of the means of assuring a maximum degree of comfort to the user, the purchase price does stand for something more important than a highly perfected superficial appearance.

Use of Hardened and Ground Parts

An example of the careful attention paid to details, which is responsible for enabling a car to operate in a way that justifies its being placed in the "luxury" class, is seen in the heat-treating and subsequent grinding of many parts that would be capable of functioning with a reasonable degree of satisfaction if they were simply machined and assembled with the steel left in a soft condition. Quite obviously, this practice of hardening and grinding such parts will add greatly to the perfection of operation of a machine, as the running action will not only be smoother when the mechanism is

It has always been recognized that the United States has led the world in machine shop practice and in the development of the methods and processes employed in metal working. Nevertheless, the full realization of the possibilities of machine tools for quantity production coupled with great accuracy came first with the development of the automobile industry into one of the leading industries of the country. It is in the automobile plants that machine tools are found to be employed in the most efficient manner, and it is here that methods have been developed for producing accurate work at low cost that are not paralleled in any other industry. Hence, in describing machine shop practice as found in automobile plants, the best commercial practice found anywhere is recorded for the benefit of other machine shops.

new, but hardness will give greater durability to those machine members which are subject to a rubbing action and thus prevent the development of lost motion that is responsible for much of the vibration and noise that characterizes the operation of some types of old cars. To those who are interested in the methods used in building motor cars, either from the standpoint of the purchaser or from that of the man who is called upon to devise methods of performing manufacturing operations on their parts, this description of a number of interesting grinding operations performed on pieces of the Cadillac mechanism will prove of interest; but particular attention is called to the fact that while these are all motor car parts that are to be ground, the methods are entirely general in their application. Consequently, men employed in the planning departments of plants engaged in many other lines of manufacture should find it possible to apply similar ideas in handling their own work.

Sound Intensifier Used in Grinding Cadillac Cylinders

In finishing cylinder block castings for the Cadillac motor, the method of procedure is to take a roughing, an intermediate, and a finishing cut in each cylinder bore, after which two grinding operations are performed. For the three boring operations, the diameter of each cylinder must come within the following tolerances: roughing cut, 0.020 inch; intermediate cut, 0.004 inch; and finishing cut, 0.003 inch. After taking the final cut, the castings are transferred to Brown & Sharpe No. 23 planetary grinders, on which the cylinders are finished to the required size and degree of smoothness. For performing these operations the diameter must be brought within a tolerance of 0.002 inch. Approximately 0.010 inch is left for removal by the grinding operation and a practice is made of dividing the cut up into two stages, so that a very light finish-grinding operation is performed to assure bringing the cylinder diameter within the required tolerance.

After rough-grinding, the cylinder block is removed from the machine and allowed to cool, so that any expansion produced through raising its temperature will be neutralized; and while taking the light finishing cut, there is not much tendency to raise the temperature. In taking this final cut, it is important for the operation to be performed in such a way that the grinding wheel is cutting to a uniform depth around the wall of the cylinder, and an experienced grinding machine operator is able to tell whether his work is properly set to attain this result by listening to the sound of the grinding wheel as it follows its planetary course around the circumference of the work. The fixture has vertical and horizontal slides so that the position of the casting may be adjusted to provide for attaining this result.

Men who are constantly employed on this part of the work have learned to determine with a surprising degree of accuracy the conditions under which one of these grinding wheels is operating, but the reliability of their judgment is likely to be seriously impaired by noises produced in handling work in adjacent parts of the shop which interfere with their ability to note carefully the sound made by the grinding wheel. To overcome this possibility of trouble, cylinder grinding machines used in the Cadillac plant are equipped with listening tubes that have one end introduced into the water jacket of the cylinder casting that is being ground, while the other end is furnished with a diaphragm similar to that used in a physician's stethoscope or in a telephone receiver. Regardless of how much noise may be produced in handling jobs that are going on near him, the grinding machine operator is able to put this sound intensifier to his ear, as shown in the heading illustration, and hear exactly how the grinding wheel is cutting all of the way around its planetary line of travel. In the performance of this operation the rate of production is eighteen cylinder blocks in a nine-hour day.

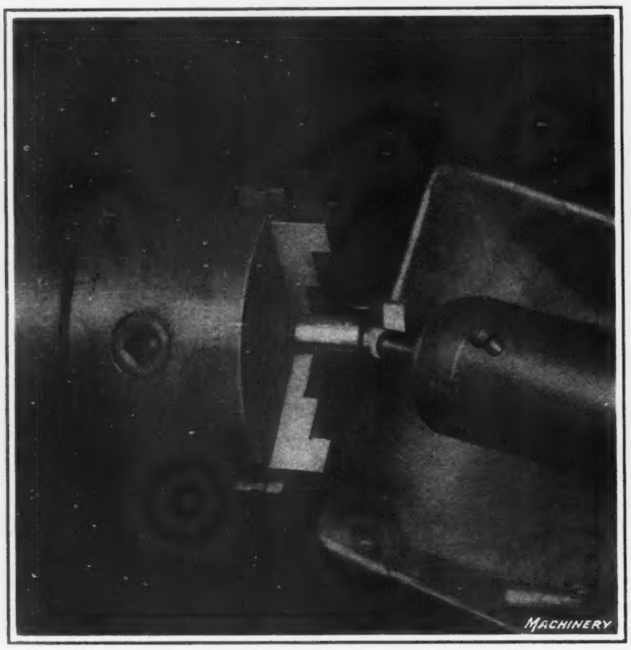


Fig. 1. Internal Grinding Machine equipped for grinding Centers in Wrist-pins

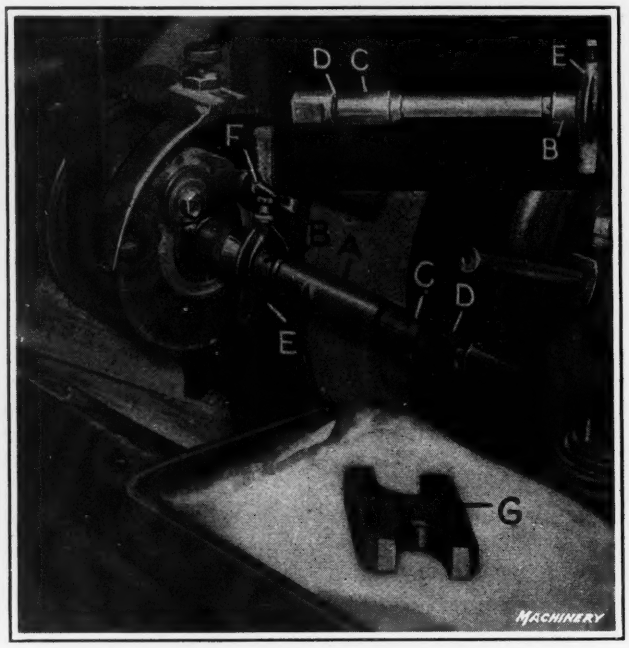


Fig. 2. Plain Grinding Machine equipped for grinding Outside of Wrist-pins

Grinding Centers in Wrist-pins

Wrist-pins used to secure the pistons of Cadillac motors to the connecting-rods, are hardened and finished to size by grinding. The grinding operation is required to bring the diameter within a tolerance of 0.0003 inch, and in order to attain this high degree of precision it is very important to have a uniform bearing surface for the tapered collars on an arbor, which support the wrist-pin by entering the holes at its ends. These bearings for the tapered supporting collars on the arbor are produced by grinding, the work being set up on a No. 75 Heald internal grinding machine, the work-head of which is placed at an angle of 60 degrees to the spindle, as shown in Fig. 1, to provide for grinding the same degree of chamfer in the work. After beveling the hole at one end of a pin in this manner, the Cushman three-jawed chuck is opened and the pin is reversed and set up for grinding a similar chamfer in the hole at the opposite end. This method of grinding not only assists in obtaining an accurate diameter for the work, but it is also of assistance in keeping the work perfectly round. In the performance of this operation the rate of production that is obtained is 700 wrist-pins in a nine-hour working day.

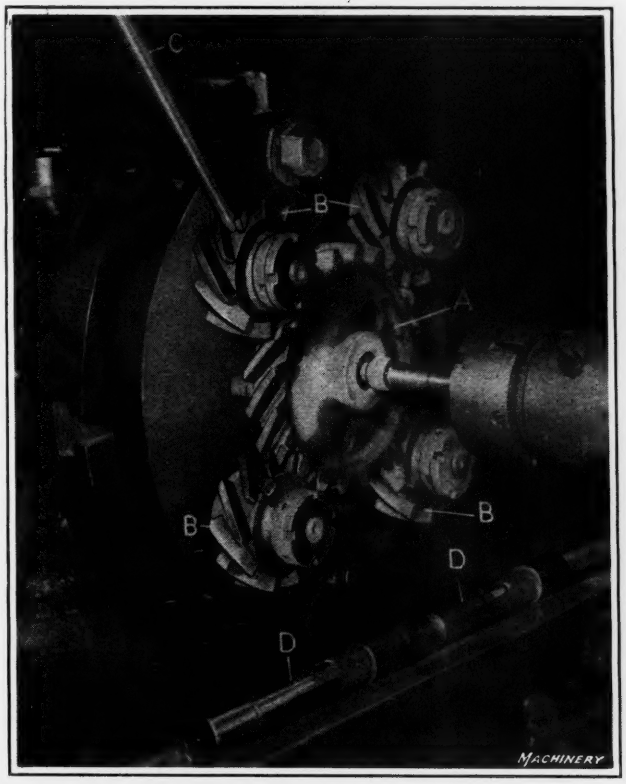


Fig. 3. Internal Grinding Machine equipped for grinding Bore of Spiral Gears

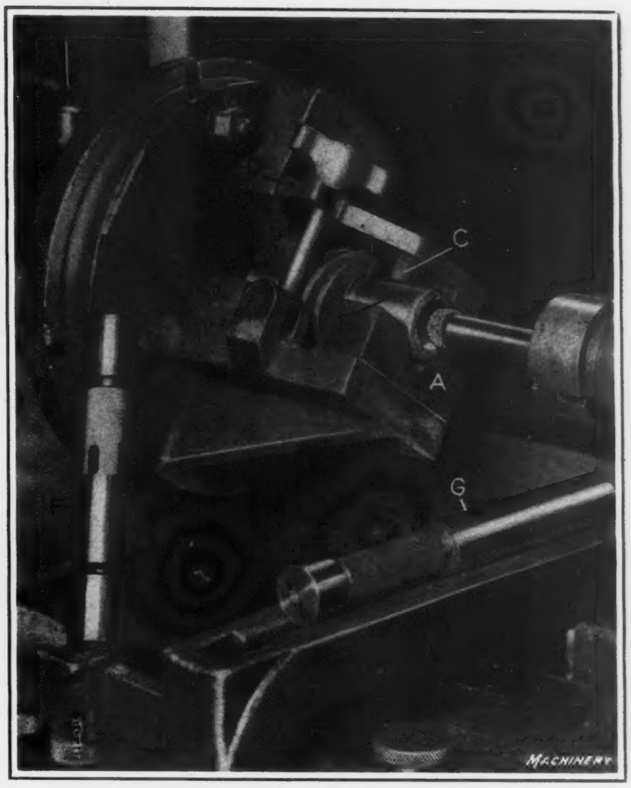


Fig. 4. Internal Grinding Machine equipped for grinding Bore of Steering Worms

Grinding Outside Diameter of Wrist-pins

Mention has already been made of the fact that the wrist-pins are required to be ground within a tolerance of 0.0003 inch of the specified size, and this job is performed on a Brown & Sharpe No. 11 plain cylindrical grinding machine shown in Fig. 2. The work comes to this grinder from the machine shown in the preceding illustration, on which the 60-degree chamfers were ground in the hole at each end, and these beveled faces are utilized as locating points. It will be seen that the arbor on which the wrist-pin *A* is set up for grinding has two collars *B* and *C*, the inner ends of which are tapered 60 degrees to fit the center bearings which have been ground for that purpose. Collar *B* is rigidly secured to the arbor, while collar *C* is a sliding fit and has a nut *D* in back of it, which screws on the threaded end of the arbor. The method of setting up the work is to remove nut *D* and collar *C* so that the wrist-pin may be slipped into place; then collar *C* is pushed forward so that its tapered end enters the hole in the wrist-pin, after which nut *D* is screwed up so that collar *C* secures the work tightly against the tapered end of collar *B*. Of course, it will be evident that the arbor is mounted between centers and that the driving of the work is accomplished by means of a dog *E* on the arbor which engages a pin *F* on the live center. A "Go" and "Not Go" limit gage for testing each piece of work as it leaves the machine is illustrated at *G*. In the performance of grinding these pieces to the close limits which are required, the rate of production obtained is 450 wrist-pins in a nine-hour working day.

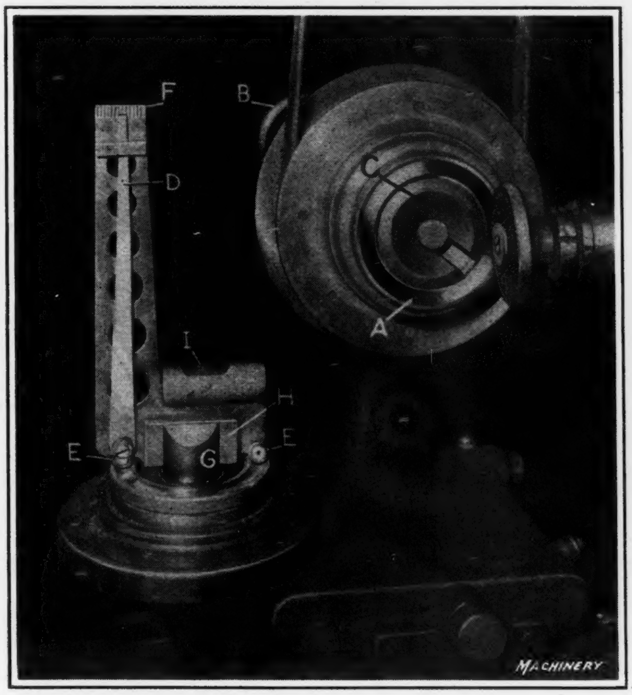


Fig. 5. Radial Grinder and Gage for grinding and testing Raceways of Ball Thrust Bearings

Fig. 6. Cylindrical Grinding Operation on Long Thin Shafts where Accuracy is Essential

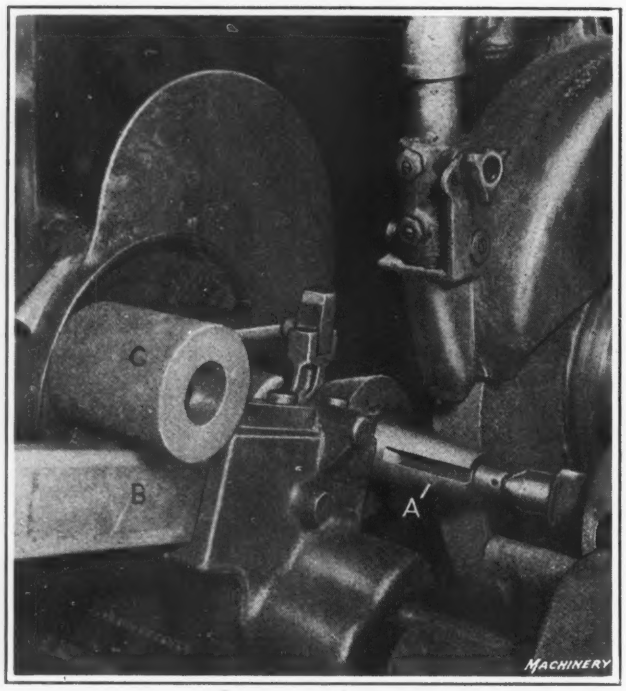


Fig. 7. Universal Grinder for grinding the Tapered Shanks of Driving Pinions

Grinding the Bore of Spiral Gears

In line with the statements which have already been made in regard to the care that is taken in finishing all parts of the Cadillac car which are required to function accurately, attention is called to the practice of grinding the bore of gears so that they will be a tight fit on their respective shafts. Fig. 3 illustrates a No. 75 Heald internal grinding machine used for grinding the bore in a spiral gear that will subsequently be assembled on the oil-pump driving shaft. On this job the method of mounting the work is one of the interesting features. It is required not only to have the bore an accurate fit on its shaft, but this bore must also be concentric with the pitch circle of the gear teeth.

It will be seen that gear *A* to be ground meshes with four pinions *B* which are eccentrically mounted on studs carried by the faceplate. A pin *C* enters a hole in one of the pinions and after the gear *A* has been brought into mesh, turning this pin causes the gear and all four of the pinions to rotate on their eccentric supports and thus move the pinions inward to serve the double purpose of bringing the pitch circle of the gear teeth concentric with the center of rotation, and of gripping the gear ready for performing the grinding operation. At *D* there are shown "Go" and "Not Go" limit gages used for ascertaining the accuracy of the hole ground in the work, which must come within a tolerance of 0.001 inch on the diameter. On this job the rate of production obtained is 120 gears in a nine-hour day.

Grinding Bore of Steering Column Worms

A somewhat similar grinding operation to the one shown in the preceding illustration is illustrated in Fig. 4 which shows a No. 75 Heald internal grinding machine equipped with a special work-holding fixture to provide for grinding the bore of a worm for use on the Cadillac steering column. Referring to this illustration it will be seen that the work-holding fixture is furnished with two V-blocks *A* in which the bearings *B* at each end of the work are clamped. Securing the work in place is accomplished by two pins, one of which is shown at *C*, that are carried by a cover-plate *D* held down on the work by a bolt and wing-nut *E*. A pin in the V-block nearest to the faceplate engages the end of the worm thread and gives endwise location. A "Go" and "Not Go" limit gage for determining the accuracy of the bore diameter ground in the work is shown at *F*, and at *G* there is illustrated an alignment gage which is used to ascertain whether the two bores in the worm have been ground accurately in line with each other. On this job the bore diameters have to be ground within a tolerance of 0.001 inch. The rate of production obtained on this operation is 100 ground worms per day.

Grinding Raceway in Ball Thrust Bearings

For use in grinding the raceway in ball thrust bearings used on Cadillac clutch spiders, a Brown & Sharpe radial grinding machine is employed, which is equipped as illustrated in Fig. 5. The raceway to be ground is shown at *A* and the machine is furnished with a draw-in spindle operated by handle *B*. At the front end of the spindle there is a C-washer *C* that slips over the head of the spindle after the raceway to be ground has been put in place. In this illustration is also shown a gage for testing the accuracy of the raceways ground on this machine. For determining the concentricity, an indicator needle *D* gives the desired information. At the base of the gage there are two round buttons *E* that enter the ground raceway, and as the work is turned under these buttons, any lack of concentricity will cause the button *E* carried at the lower end of indicator needle *D* to swing the upper end of this needle over a scale graduated at *F* thus showing both the presence of an error and its magnitude.

It is also necessary to test the depth of the raceway, and the position assumed by buttons *E* in the ball groove is the determining factor in making this measurement. At the center of the base of the fixture, there is a post *G* that is slotted to receive the flat plate *H* on the frame which supports the mechanism. Plate *H* slides down in the slot in post *G* until the buttons *E* contact with the bottom of the raceway, thus preventing any further downward movement. Sliding through the frame it will be seen that there is a pin *I* one-half of the top of which is ground to one height and one-half to another height. In the case of a raceway in which the groove has been ground to the proper depth, the upper half of this pin will project above the surface of the frame, while the lower half will be below the surface. Of course it will be evident to all experienced mechanics that this method of making a "Go" and "Not Go" limit gage to test the depth of the raceway is based upon the familiar "feeler" principle. After putting a piece of work in place in this gage, the operator slides his thumb or finger across the top surface of the frame, and if he is able to feel the upper half of pin *I* but not the lower half, the depth of the raceway comes within the required limits of tolerance. In grinding these raceways, the radius of the groove is required to come within a tolerance of 0.001 inch, and the diameter

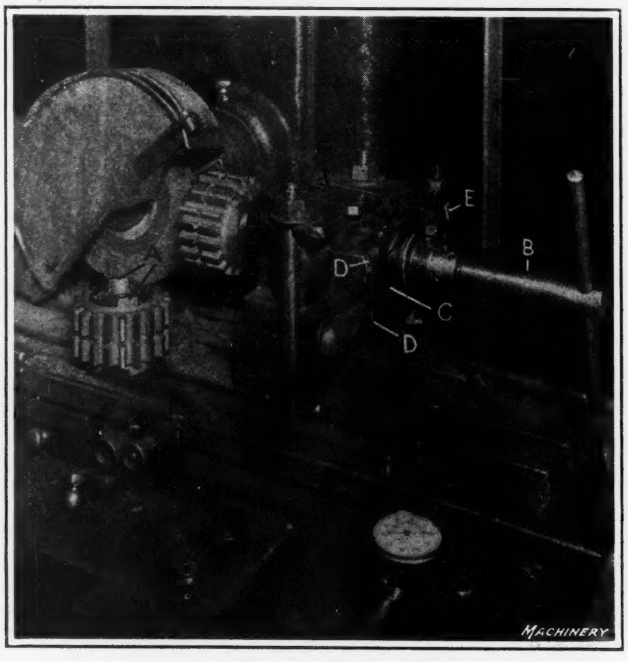


Fig. 8. Indexing Fixture on Grinder for grinding Opposite Sides of Keys A on Crankshaft Gear

of the raceway must be within a tolerance of 0.003 inch. The rate of production obtained is 300 raceways in a nine-hour working day.

Grinding Rocker Arm Shafts

Fig. 6 illustrates a grinding operation on which it will be conceded that an unusually high degree of accuracy is attained, if the long slender form of the work is taken into consideration. The pieces to be ground are hollow shafts, and it is required to hold the outside diameter within a tolerance of 0.0005 inch in performing the grinding operation. As in the case of the wrist-pin grinding job previously described, a practice is made of preparing bearings at the ends of the work to receive the centers on which the piece is supported for grinding on a Norton plain cylindrical grinding machine. It will be evident that with a long slender piece of work of this kind, care must be taken to support it in such a way that inaccuracy will not be introduced through the pressure of the grinding wheel causing the work to spring. Reference to the accompanying illustration will

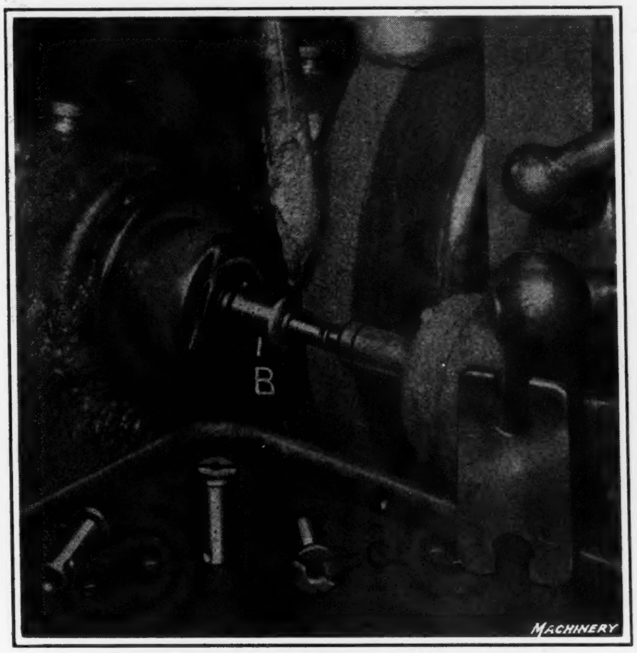


Fig. 9. Machine equipped for performing Cylindrical Grinding Operation on Small Flanged Pins

make it apparent that such support is afforded by means of a rest *A* which engages the work near the center. At one end of these rocker shafts there is a slot, and the live center that enters the work at this end is provided with a key to engage this slot and provide a means of driving the work. On this job the rate of production is 250 ground shafts per nine-hour day.

Grinding Tapered Shanks of Driving Pinions

On the driving pinion of the Cadillac motor, there is a tapered shank which must be finished by grinding to bring the diameter within a tolerance of 0.001 inch, and for the purpose of this operation a Norton universal grinding machine is employed, which is equipped as illustrated in Fig. 7. In this illustration the tapered shank of the driving pinion to be ground is shown at *A*, the work being supported on the usual arrangement of centers and driven by a dog, while the grinding machine table is set to the proper angle to give a taper of 1½ inches per foot. Attention is called to the fact that it is also required to grind a square shoulder on the pinion shank, and to provide for so doing, the grinding wheel is under-cut at the side. This practice makes it necessary to employ a "center finder" that is supported at the forward end of the sliding bar *B*, this device being employed to obtain the desired longitudinal location of the work for the shoulder grinding that is done by the side of the wheel. At *C* there is shown a ring gage that is used for testing the accuracy of the ground tapered shank. In performing this taper grinding operation the output attained is 250 driving pinions per day.

Grinding the Clutch Key on Gears

On the intermediate gear on the Cadillac crankshaft there is a clutch key formed integral with the gear, and it is necessary to accurately grind the side faces of this key. Reference to Fig. 8 will make it apparent that one of the gears on which the key is to be ground is shown in place on the grinding machine, while another gear will be seen standing on the table, and on the latter piece of work the form of key to be ground is clearly shown at *A*. This grinding operation is performed on a Brown & Sharpe No. 2 grinder equipped with an expanding arbor manipulated by a tapered pull-pin to provide for gripping the work. The key has to be ground on its two side faces, and so provision must be made for indexing it through 180 degrees preparatory to the performance of the second grinding operation that is required on one of these pieces. The expanding arbor on which the work is carried is mounted at the end of rod *B*, and secured to this rod there is also a flexible blade *C*. When the gear is indexed through 180 degrees, this blade swings over from the position in which it is shown in Fig. 8 so that it is pointing toward the back of the machine.

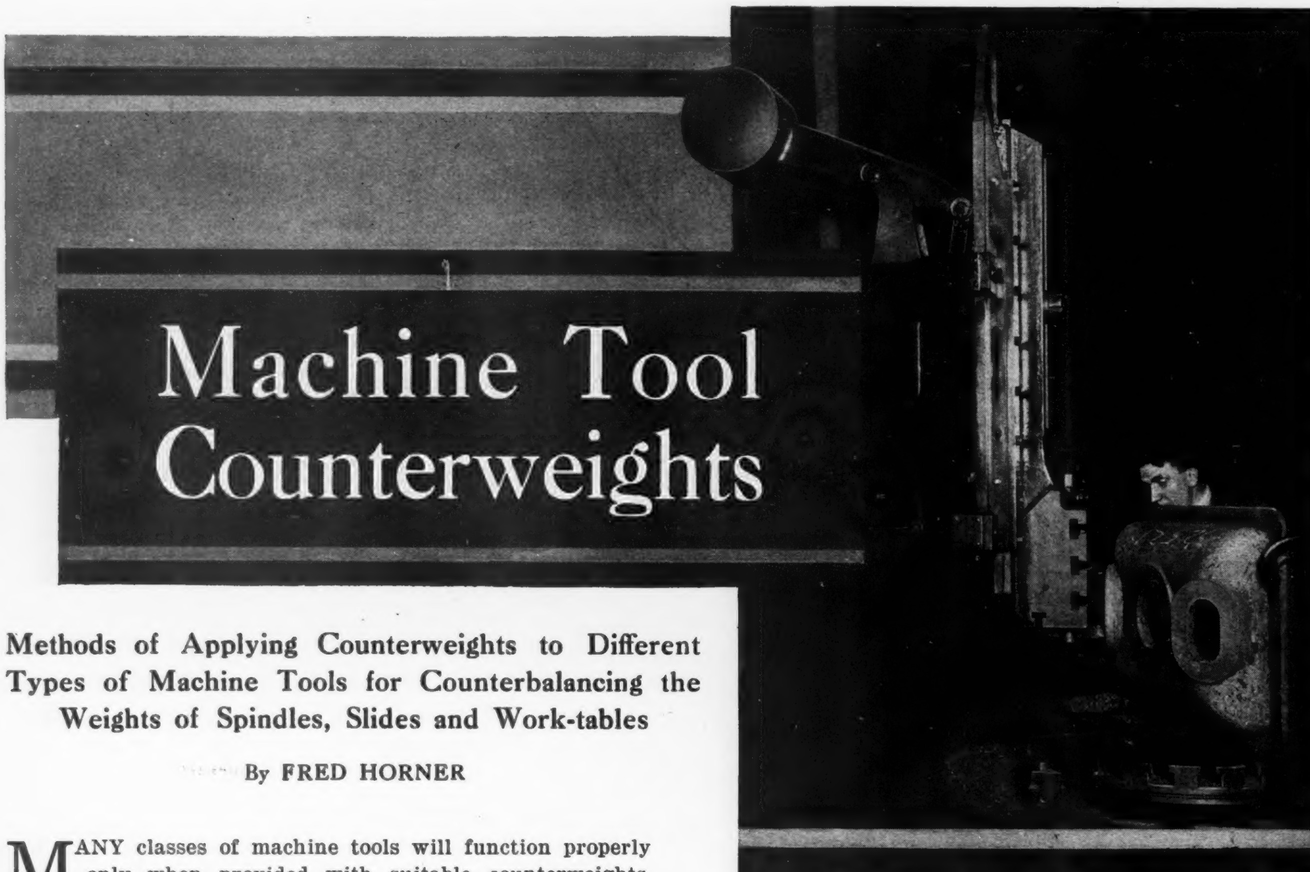
It will be seen that there are two latches *D* which engage the upper and lower edges of blade *C*, thus holding it in place and preventing rod *B* and the work from turning. To index the gear for the second grinding operation, it is merely necessary to take hold of the handle on blade *C* and push it toward the right until the blade is clear of latches *D*, after which the handle is swung through half a turn, so that blade *C* comes between two latches, one of which is shown at *E*. This locates the work in the proper position for performing the second grinding operation. On this job the actual grinding is done with the flat side of the wheel. The limits of accuracy are not particularly high, as it is only required to hold the work within a tolerance of 0.001 inch. The "Go" and "Not Go" limit gage for testing the accuracy of the ground key is shown at *F*. An output of 300 gears per nine-hour day is obtained on this operation.

Cylindrical Grinding Operation on Cam-roll Pins

Fig. 9 shows a No. 11 Brown & Sharpe plain grinding machine equipped for the performance of an operation which is of interest, owing to the small size of the pieces to be ground. These are valve rocker roller pins and their form will be best understood by reference to the three pieces *A* that are shown lying on the tray at the front of the grinding machine. The diameter of the shank must be ground to come within a tolerance of 0.0005 inch. It is the grinding of this shank that is done on the Brown & Sharpe machine, and for the performance of this operation the work is held by a center at the right-hand end, while at the left-hand end the flange enters a counterbore in chuck *B*. In one of the pieces of work lying on the tray in front of the grinder, it will be seen that there is a slot *C* milled across the flange and this slot is utilized for driving the work by having a diving key in chuck *B* arranged to enter this slot. An arrangement of this kind enables these small pieces to be set up for grinding with a minimum loss of time. The rate of production obtained on this operation is 1800 to 2000 pins in a nine-hour working day.

* * *

An exhibition of all types of calculating machines was recently held in Paris to commemorate the one-hundredth anniversary of the invention of the first commercial calculating machine by an Alsatian named Thomas, who, in 1820, brought out the first model of this type of machine. It is interesting to note that the five principal inventors and pioneers in the field of calculating machines, as far as the establishment of principles is concerned, all belong to France: Pascal, Thomas, Maurel, Jayet, and Bollée.



Machine Tool Counterweights

Methods of Applying Counterweights to Different Types of Machine Tools for Counterbalancing the Weights of Spindles, Slides and Work-tables

By FRED HORNER

MANY classes of machine tools will function properly only when provided with suitable counterweights. In most cases, the principal problem encountered when designing counterweights for such machines is to so locate them that they will give the least trouble and inconvenience. They must be placed where they will not interfere with the operator or the work, belts, shafting, controlling levers and rods, motor gear, or other essential details. The fulfillment of this condition depends on many factors, and differs widely in various types of machine tools, the disposal of weights being a simple matter in some instances, and more difficult in others. The mass of the balance weights, their shape, and the profile of the area available for their location are the principal factors that affect the problem. In certain forms of machines the counterweights cannot be placed anywhere near their point of immediate action, but have to be attached to chains or ropes, passing around pulleys and rollers, to some rather distant position.

Counterweights for Spindles, Slides, and Tables

The movement of the slides or spindles to be counterbalanced sometimes necessitates making holes or wells in the floor into which the weights can sink, while in other cases it may be practicable to pass them down into hollow columns, or down the backs of the columns. Other factors to be taken into account are whether they must be of a constant weight, or whether they require modification to meet various working conditions, and also whether the traversing motion of a slide or spindle tends to induce an oscillating or swaying motion, which will be transmitted to, and aggravated by, the counterweight. Where the action of a counterweight is required to be constant, the mass is always the same when the weight of the slide or spindle or both does not vary, or when it varies only a small amount, due to the changing of tools and tool-holders mounted on the slide or in the spindle. Certain kinds of slides require more or less modification of their counterweights when different machining operations are performed, due to the variations in the shape or weight of holders, tools, or special fixtures. Work-table counterweights require an even greater variation in this respect because the mass of the work, and of the jigs and

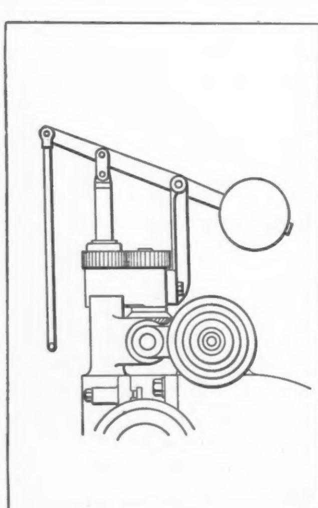


Fig. 1. Directly Applied Weight

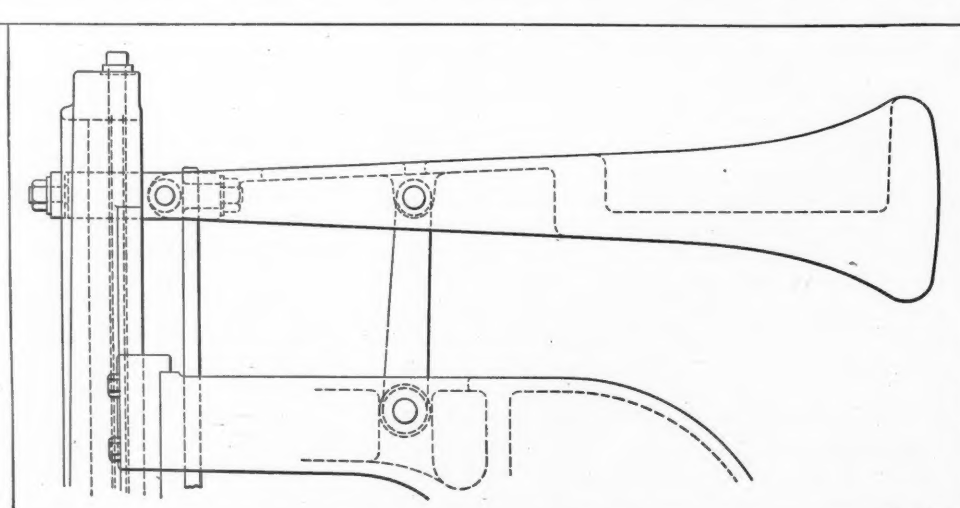


Fig. 2. Method of Balancing Slotter Ram

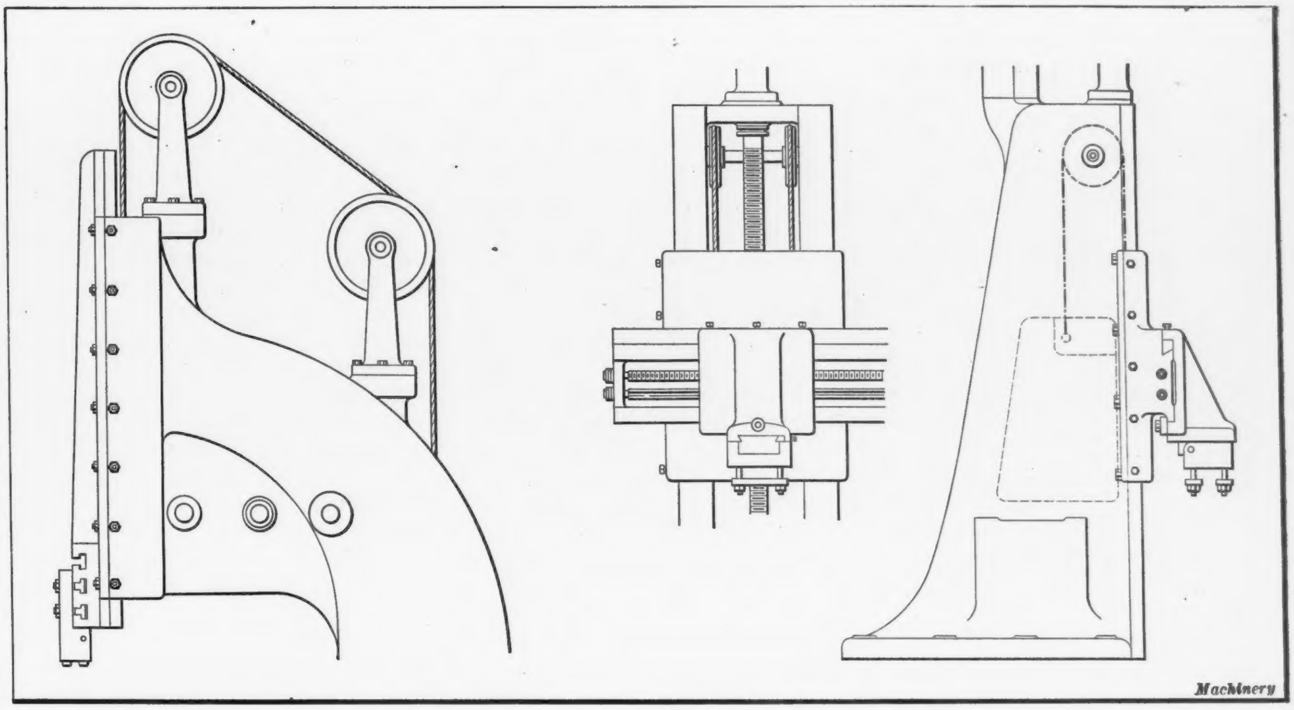


Fig. 3. Placing of Counterweights on Large Slotting Machine

Fig. 4. Machine with Counterweight located inside of Column

fixtures, causes greater differences than do the tools. Hence the construction of counterweights for work-tables must be such that their weight may be readily increased or reduced.

In some cases changes of counterweights have to be made because of the angular setting of slides, the particular manner in which tools operate, or to secure the elimination of backlash under variable working conditions. The effect produced on the action of a counterweight when angular settings of a slide or spindle are made must be considered when designing the counterweight. In cases of this kind the weight must be so placed that it will accommodate itself to the altered conditions; this applies not only to the matter of prevention of swaying and displacement, but also to the results that are incurred by throwing the mass over at an angle. Occasionally this deflection is of little or no consequence, but often it is important. A solution of the problem may be obtained in some instances by leading chains or ropes around suitably located idlers that will bring the weight away from the working zone. In recent practice this problem has been solved by the substitution of springs as counterbalancing agents, notably in boring and turning mills, and radial drilling machines, so the objectionable weight of the counterbalance, and the problem of adapting it for use where angular settings are required, have been eliminated.

Even where the movements of a slide are not such that actual tendency to oscillation is set up, the presence of a loose swinging weight may cause minute variations in the cut, as this may result from the flexure of a frame or slide. Consequently the preventing of swaying even in a slight degree may be desirable. Usually it becomes imperative, because the swinging of a weight of any shape, or the twisting of a weight of rectangular shape, would cause it to interfere with the other machine parts, especially in places where the available space is restricted.

Principles of Counterweight Design

The employment of two or more weights for counterbalancing a single member is sometimes desirable. For in-

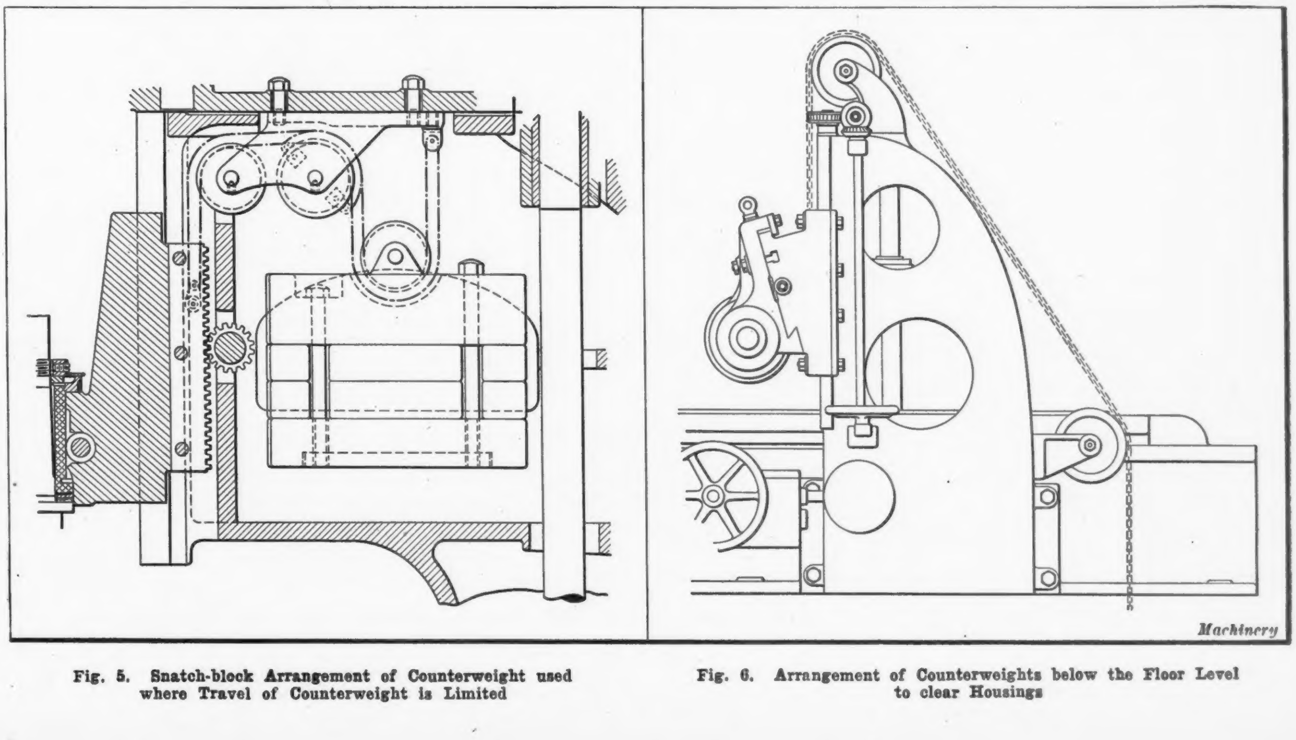


Fig. 5. Snatch-block Arrangement of Counterweight used where Travel of Counterweight is Limited

Fig. 6. Arrangement of Counterweights below the Floor Level to clear Housings

stance, a long slide may be of such dimensions that it cannot be successfully dealt with by a single weight and attachment, because the pull would be too localized—a condition which would result in the sagging of the slide at the ends to an extent that would seriously affect the operation of the machine. In a slide of this kind, as well as in a deep heavy slide, the weight of the counterbalance is often so great that it would impose too great a stress upon a single anchoring rope or chain; or it may be of such weight that a single wire rope sufficiently strong to sustain the pull of the weight and the slide would be excessively stiff, and therefore difficult to bend around a pulley, even though a pulley of large diameter were used. The crushing and bending influences upon the frame have to be taken into account also, and the pressure caused by the pull of the chains should be properly distributed so that the metal will not be sprung in at weak places or warped laterally.

The location of screws, racks, feed-rods and other elements play their part in affecting the placing of the chains or ropes, while other factors are the question of the displacement that takes place when a sliding member is moved to its extreme positions, and the manner in which the balanced slide

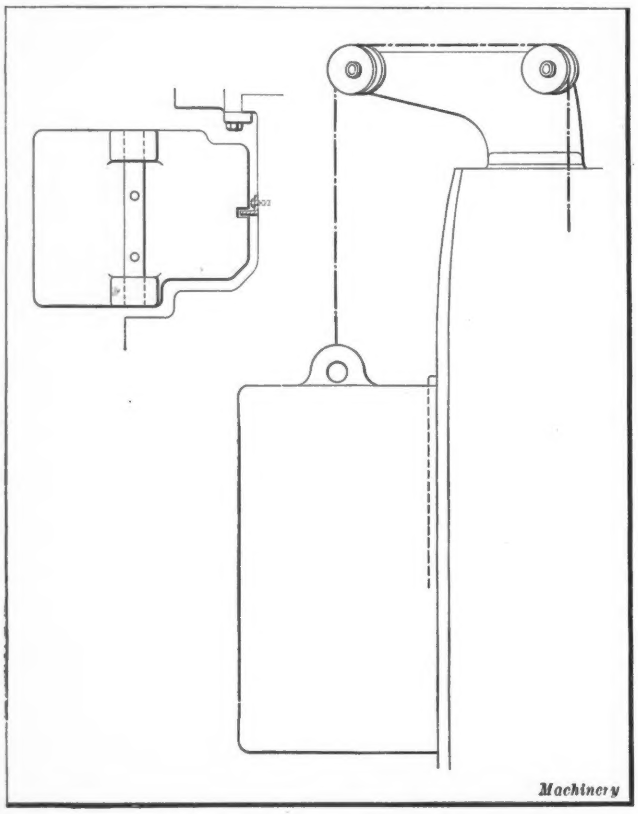


Fig. 7. Counterweight with Angle-iron Guide to prevent Swaying

is guided vertically. Usually the maximum pull of the rope should come approximately midway between the extreme positions of the sliding element, so as to provide an average or even effort that will not tend to twist or tip the slide on its ways. The location of a narrow guide may exercise a modifying influence, and it may be desirable or imperative to set the anchorage of the rope approximately in line with the line of guidance, just as is done in the case of the actuating screws or other driving agencies employed with narrow guides, the screws or racks being situated as nearly in line with the guides as practicable. This discussion as to the hang of the rope only affects its coming down from the first pulley overhead, for after reaching the first overhead pulley the direction of the rope can be diverted in almost any convenient direction.

Conditions that Affect Design of Counterweights

The relative importance of a balance weight is affected by the type of feed or movement through which a slide, spindle, or table receives its motion or adjustment. Thus, in vertical rack-fed machine parts there is nothing to prevent the instant sliding down of the part as soon as the pinion is free to revolve; but in screw-fed or worm-fed parts, the self-sustaining principle comes in; hence varying sets of conditions affecting the design are met with. In one case a rack feed will prove an advantage, allowing a slide to be rapidly adjusted, fed, or withdrawn; it also permits a spindle, such as used in light drilling machines, to fly up to the starting point as soon as the hand pressure is released, and it adds to the sensitiveness of the control. In movements that must have compensation for variations, such as are necessary in profiling or cam-cutting operations, the rack affords an elastic medium for letting the movements take place. The cross-rail of a planing machine, because it is self-sustaining, has been generally neglected from the point of view of balance, though plano-miller cross-rails are always balanced, presumably because they usually carry a greater weight in the form of spindle, driving means, arbors, etc.; but examples of counterbalanced planer cross-rails are not entirely lacking, and it is likely that the practice will extend so as to reduce power costs, or human exertion, as well as the wear on the surfaces of the actuating screws, gears, etc.

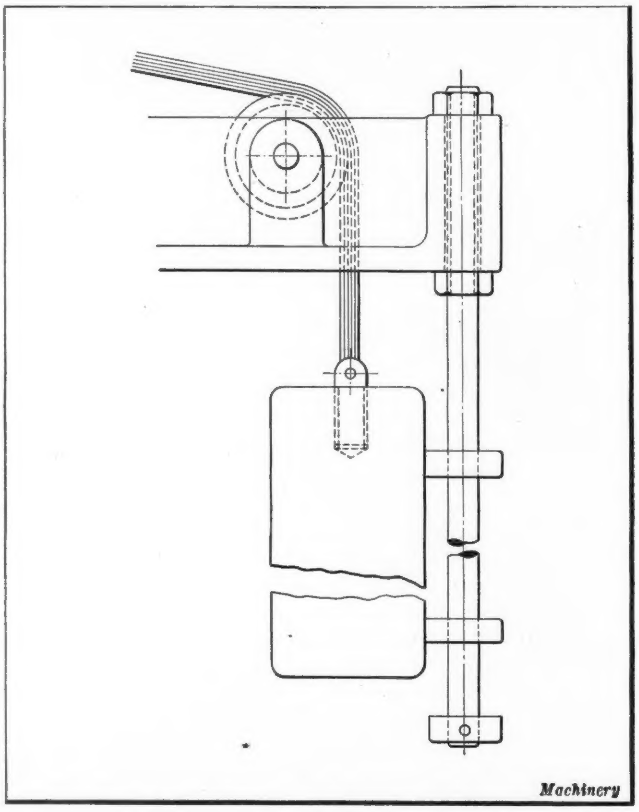


Fig. 8. Counterweight which is guided by Rod suspended from Bracket

Different Methods of Counterbalancing and their General Application

What may be termed direct balancing is used when a constant to and fro movement of a weight and attaching medium would not be desirable, or perhaps practicable; it is also used in the case of a great many lever feeds and adjustments, the direct attachment of a weight being the simplest and best construction. This principle is applied to both hand- and power-operated parts, to cause return of the part ready for another movement, or to maintain a tool, roller, or pin in continuous contact. With the latter type we are not concerned in this article, for this contrivance does not come under the head of a counterweight proper, but is a feed weight, such as used in hacksawing machines, circular cold saws, and certain other machines.

The most common use of a directly applied counterweight is found in certain types of drilling machines that have a lever feed, the operator's hand being placed upon the projecting end, or upon a pull-rod. The weight then occupies a position more or less near the other extremity of the lever,

as shown in Fig. 1. For tapping spindles, this system is peculiarly applicable, because tapping machines have to be self-feeding after the tap has started; hence the nicety with which their spindles are balanced affects the operation and the quality of threads produced. The balancing of a slotting machine ram, such as shown in Fig. 2, exemplifies the equalizing principle, which is here employed to eliminate friction and save power in order that an even, steady movement may be secured. This device is seldom employed, however, on the largest machines, where the great mass of such a weight would become objectionable. For larger machines, some such disposition of the weights as illustrated in Fig. 3 is necessary, the ropes or chains being brought down to the most suitable place for the counterweights, either into the frame, or down the back of it. The choice of position is usually determined by the arrangement of shafts, pulleys, motor, and other details. Sometimes, as in the case of portable slotters, the arrangement illustrated in Fig. 4 can be employed, in which the whole counterweight tackle is carried within the column.

The restricted depth behind the sliding head is occupied by weights suspended in snatch-block fashion, so that half their effective pull is transmitted to the head, with a doubled length of movement. The opposite arrangement is encountered in some designs of multiple drilling machines which have very tall columns, on which the sliding heads do not travel more than about half their length, owing to the great depth of the head mechanism. Here the head is hung to the snatch-block pulley, the anchored end of the rope goes up to an attachment on the overhanging bracket at the top, and the free end passes around the top pulley and down to a set of weights inside the column which are approximately half the weight of the head.

A similar result is obtained by the wheel-and-axle device which is occasionally employed on plano-millers and other tools having similar requirements. With this method two pulleys are cast or otherwise fastened together; the rope attached to the slide is fastened to one side of the small pulley, and that of the balance weight to the opposite diameter of the large pulley, which is twice the size of the other.

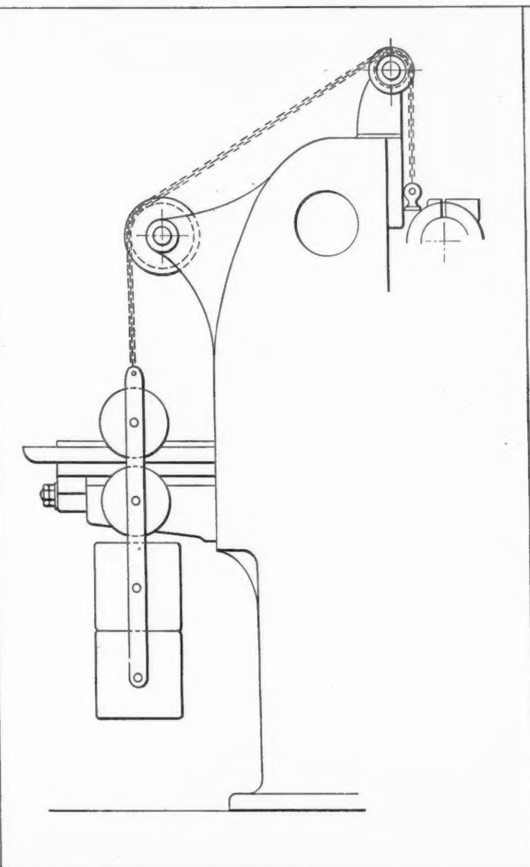


Fig. 9. Arrangement of Weights where Space is Limited

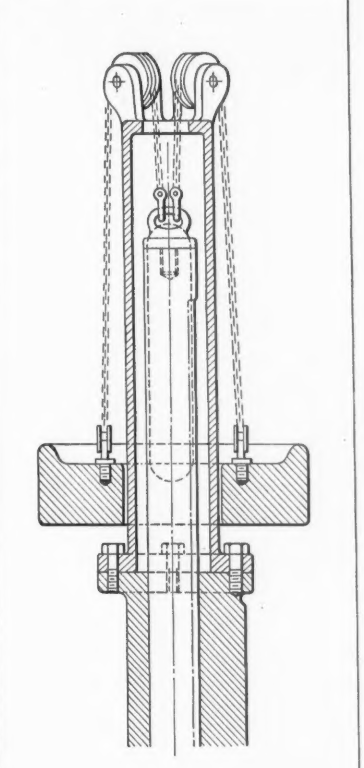


Fig. 10. Ring Counterweight for Drilling Machine Spindle

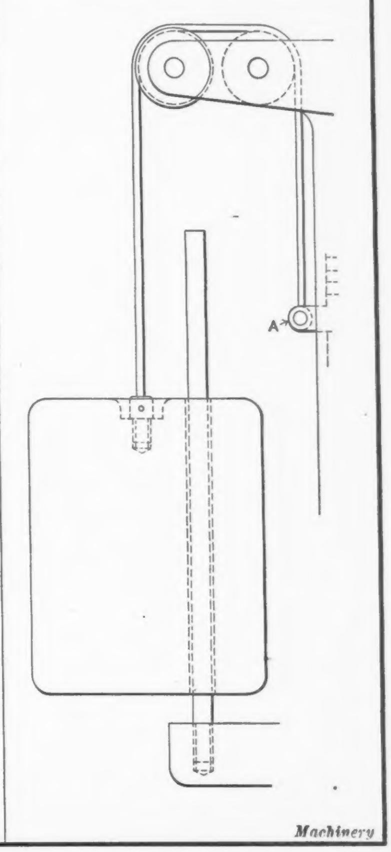


Fig. 11. Counterweight which slides over Guide Rod

Pillar drilling machines, such as shown in Fig. 13, are another type of machine in which the pillar provides a suitable container for the weights. In this case it will be seen that both the mass of the table and of the drill head are balanced by weights enclosed by the pillar. A weight is also used in some instances for balancing the rack sleeve instead of using a coiled spring, which is the method commonly adopted. Another departure from conventional methods of counterbalancing consists in using an equalizer bar which is coupled to the sleeve and sliding head, and chained to a single weight within the column. In these drilling machines no limitations of vertical length of movement hamper the placing of the weights, nor do they, as a rule, in some other types of machines, such as vertical milling and vertical boring or chucking machines. But when the contour of the frame is such that there is no clear drop for the weight, a modification of the system must be sought.

An example of this may be observed in Fig. 5, which shows the arrangement employed in a vertical milling machine. The leverage gained on the greater diameter of the counterweight pulley, by a reduced weight and extended length of drop, thus acts on the smaller pulley and thence on the slide. This arrangement is feasible only when the vertical movement of the slide is such that the available space is of sufficient length for the fall of the weight.

The disposal of weights in a machine having a frame of parabolic shape is made difficult when the driving and control gear occupies the spaces beside the curved frames, for then it is usually necessary to run the weights down below the floor level, as in Fig. 6. But often a space of sufficient area to accommodate the weights can be found if the weights are flattened or shaped so that they will just clear the driving and control details. In some cases, guide strips may be fastened to the floor and to brackets at the top, extending beyond the parabola, and the weights thus kept in position. If there is enough space for the weight to slip down the back of the standard, it is often placed this way. This method is commonly used on horizontal boring and drilling machines.

Guide strips are included to promote smooth working and prevent swaying. Even on a straight-backed standard the latter consideration has to be borne in mind, especially when a slight lateral displacement would cause the weight to come into contact with parts of the machine. A shaped or specially formed weight which is guided by an angle bar is shown in Fig. 7. An example of counterweight disposal where the space for drop is ample, but the lateral space rather cramped, is shown in Fig. 9. In this case the employment of flat weights mounted on pins passing through a pair of side bars forms a construction which permits of modifications both in width and depth, as may be required to suit different conditions.

Counterweights Provided with Guide Rods

When a weight is located in a comparatively open space with considerable clearance around the weight, the provision for prevention of swaying may take the form of a guide strip or strips, or a tube into which it descends, or the weight may be cast in tubular form, to slide over a rod or tube, this being rather convenient, as it permits the addition of extra ring weights as required. The principle of an encircling weight is favored in drilling machine spindles and those of massive size on boring and turning mills for deep boring operations. The ring weight is placed around a tube encircling the end of the spindle, and the chains or ropes pass up over two or three pulleys and down to the spindle top, or an extension of the spindle. A drilling machine spindle thus arranged is shown in Fig. 10.

On the saddles of radial drilling machines, where compactness is desirable, the balance weights are designed to fit as snugly and closely as possible to the spindle and guiding ways, so that the swaying tendency will be reduced to a minimum, and the uneven twisting effort also eliminated as far as possible. A guiding bar is generally fixed so as to pass through the weight, or through lugs on the weight, and should be a close fit in the hole. A few variations of this type of counterweight design are shown. In Fig. 11 there is a rod screwed into a bracket extending from the saddle casting, and the weight is passed over this, the chain going up, and thence down to a ring *A* on the spindle nuts, the ring having a lug that is slotted out and drilled to suit the anchoring end of the chain. Usually it is more convenient to hang a rod down from a bracket adjacent to the chain pulley, such as shown in Figs. 8 and 12. A nut or a pin ought to be placed at the bottom of the rod to catch the weight in case of chain failure. A very snug-fitting counterweight is shown in Fig. 14, where the weight is cast of such shape that it will ride high up around the pulley. The guide rod, in this case, is made square, to prevent twisting.

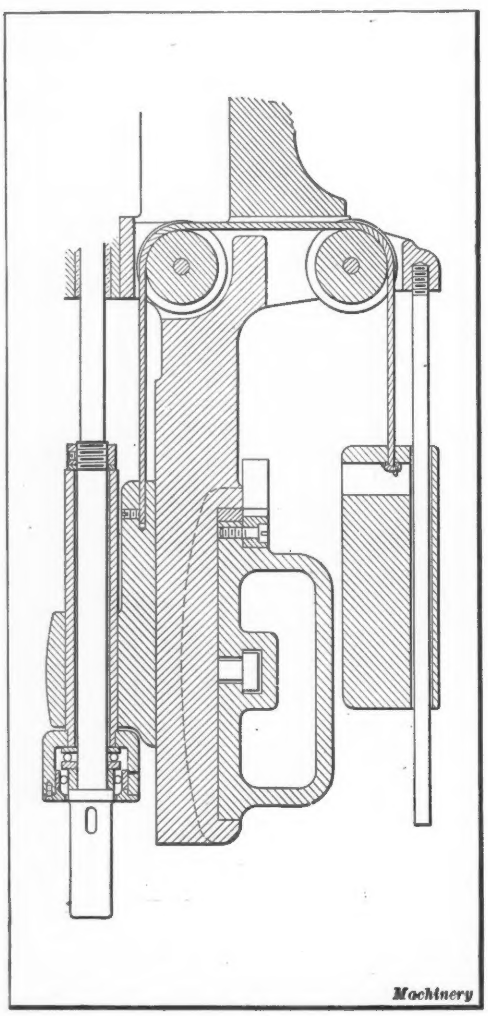


Fig. 12. Counterweight provided with Guide Rod to prevent Swaying

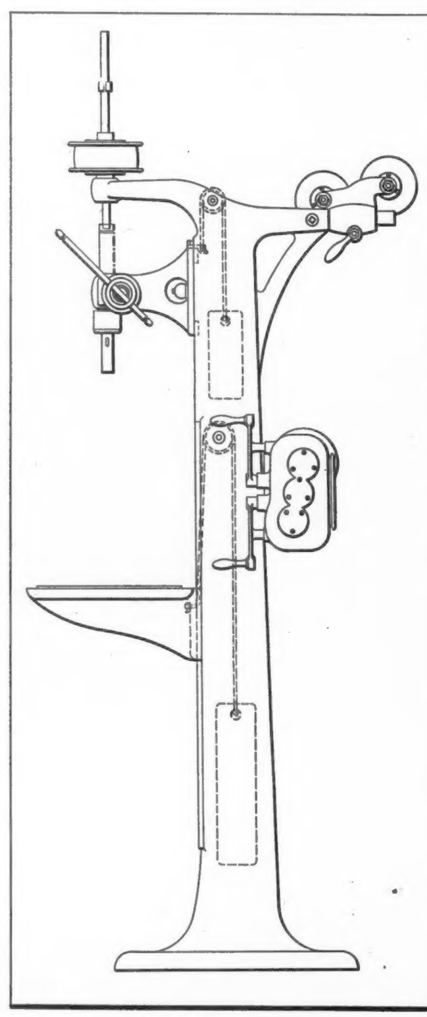


Fig. 13. Drilling Machine with Counterweight enclosed in Pillar

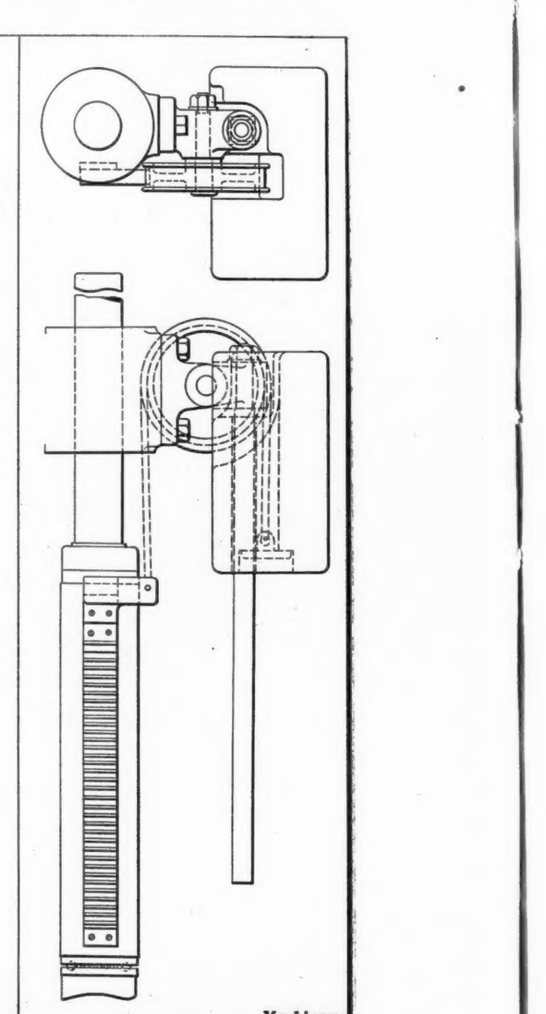


Fig. 14. Counterweight which clears Supporting Pulley

Counterweights Located Some Distance away from the Point where their Force is Exerted

The proper disposal of counterweights at some comparatively distant point from the spot where their force is exerted is a problem which occurs in designing boring and turning mills. As the front of the machine must be entirely clear from encumbering weights, it is necessary to locate them either above the framing, or at some place at the side or rear of the uprights.

In only a few designs can the weights be located at the front, these being principally in case of the counterbalancing of light rams or spindles, a feature also encountered in plano-millers. The long boring rams fitted with encircling weights, mentioned previously, are not in the same category, because the top of the ram extends to such a height that it is out of the way of the work and the operator. The prac-

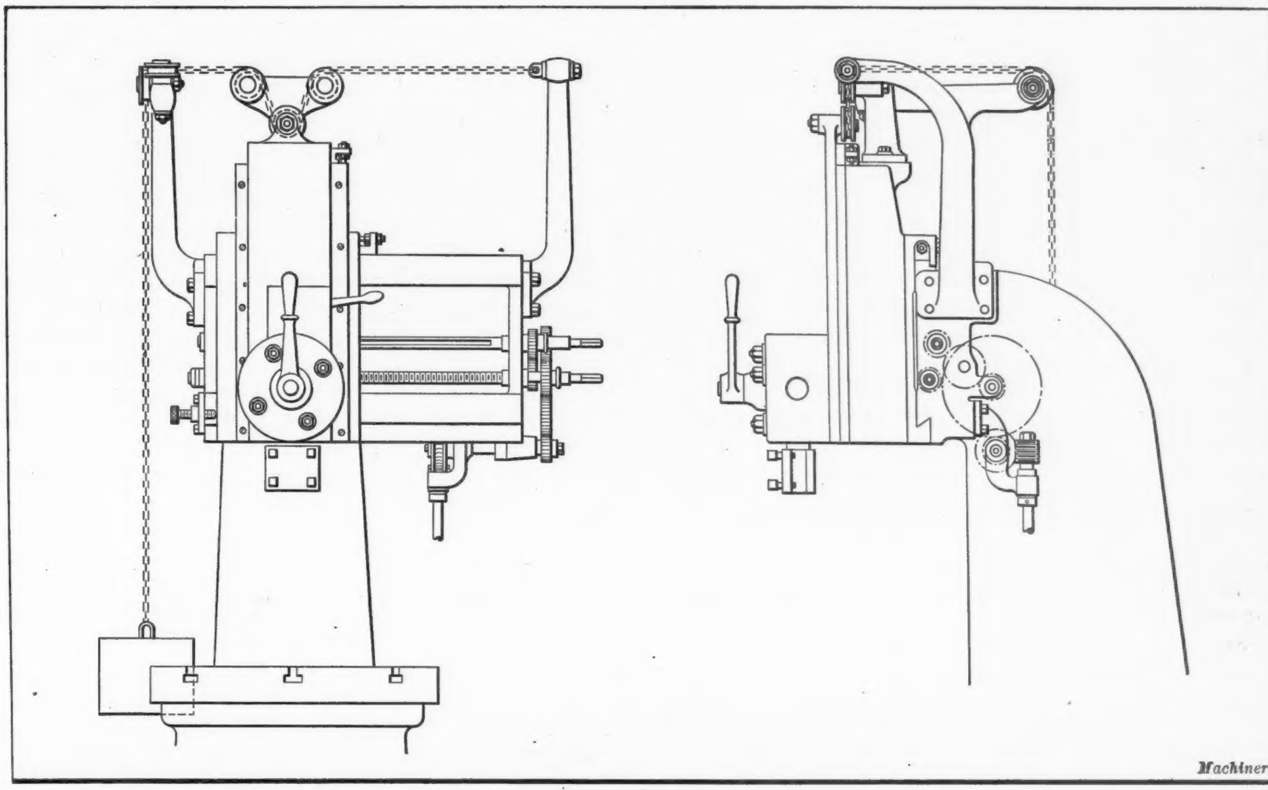


Fig. 15. Chain Arrangement for Counterweight of Boring Mill

tice of mounting tall standards on the top of the cross-girder of a boring and turning mill is often followed, the standards carrying the pulleys. Usually, however, the familiar horizontal chain arrangement is employed, the chain passing around pulleys that deflect its course from the horizontal to reach down to a pulley on the ram, by which the latter is lifted. A simple lay-out for a small boring mill is shown in Fig. 15. With this arrangement the various movements of the ram and saddle do not interfere with the motion of the chain. In larger rams, the pulley on the ram is carried farther down, sometimes being located a distance from the top of the ram that is equal to half its length, and sometimes being located close to the tool-holder, thereby providing for a greater length of feed.

The common practice of attaching the anchorage of the counterweight directly to the slide to be balanced does not provide a perfect means of sustaining the weight, because a slight backlash between the teeth of the pinion and gears connecting thereto may allow the tool or cutter to drop so that it will dig into the work. Therefore, some designers prefer to maintain a reverse tension against the feed pinion, and thereby sustain the weight of the slide and at the same time absorb backlash between the intermeshing teeth. A vertical milling machine having such a provision is shown in Fig. 16, where it will be seen that the end of the chain is secured to a wheel *A*, keyed on a shaft carrying a gear which meshes with the rack pinion. The latter may be operated by hand or power through the shaft *B*. On one

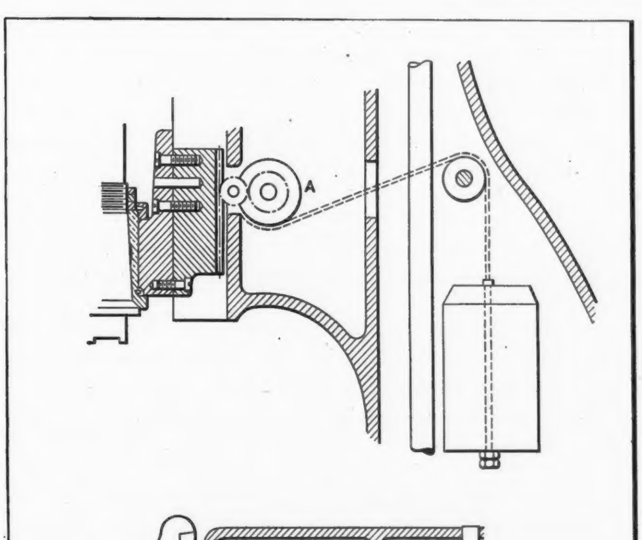


Fig. 16. Counterweight Arrangement for absorbing the Backlash between the Feed-gears

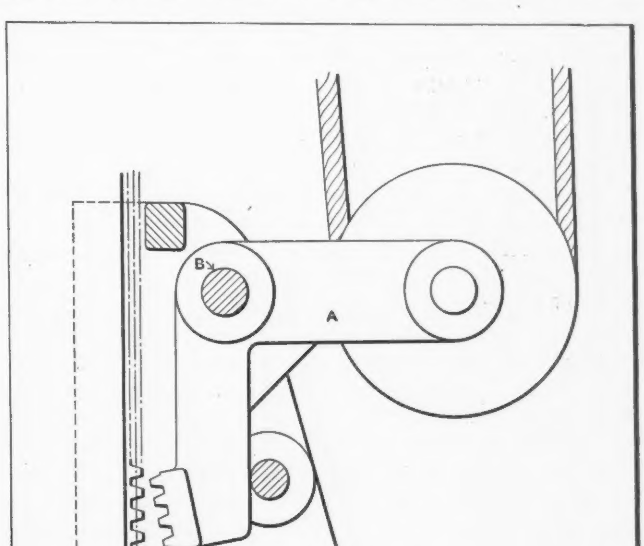


Fig. 17. Safety Arrangement for locking Slide or Spindle in Case Weight Chain fails

type of vertical turret lathe a modification of this principle is employed, the balancing effort being applied to the feed rack in the slide through a separate pinion, concentric with the feed pinion. In this manner an upward tendency is exerted against the teeth of the feed pinion.

The chances of a cable or its connections breaking are rather remote, as a high factor of safety is provided for. But if this should happen, the consequences would be much more serious in some kinds of machines than in others. The more costly effects, for example, would arise from the dropping of a gang of drills on the drilling machine table. To prevent such accidents, one of the machine tool builders furnishes an automatic safety catch of the kind illustrated in Fig. 17. Should the cable fail or the weights become detached, the anchorage arm *A* drops down, and in swiveling on the pivot *B* throws the rack portion into engagement with the feed rack.

* * *

PUMPS FOR CORROSIVE LIQUIDS

The development of the chemical industry continually makes demands upon the manufacturer for apparatus of a special kind which is required to operate under conditions which call for properties entirely outside the ordinary characteristics of mechanical equipment. Attention is called to this question in a recent issue of *Engineering*. Strongly corrosive liquids have to be pumped and stored, often at a high temperature and considerable pressure, and not only must this be done with complete safety to the operators, but the apparatus must be neither dissolved, corroded or eroded in the process. Should the pumps, piping or vats be attacked by the substance in contact with them, their rapid destruction might be the least of the trouble. Any such attack would necessarily contaminate the chemicals with the dissolved material, and might easily be serious enough from this point alone to render the process impracticable.

When the conditions are very severe, pumps of the reciprocal type are out of the question, as the centrifugal pump with its natural simplicity of construction, its absence of internal rubbing surfaces and its freedom from valves possesses obvious advantages. Centrifugal pumps, therefore, are widely used for pumping corrosive liquids, and they are made of various materials. Ferro-silicon will resist some acids, but cannot be used for hydrochloric acid or in processes where contamination with iron must be avoided. Lead and regulus metal are also used for pumps, but are unsuitable for some acids and for solutions containing metallic salts. Ebonite pumps have been built, but these naturally will not withstand hot liquids, while certain chemicals will attack them. Moreover, ebonite is a bad material for rubbing surfaces.

The substance which is most generally suitable for resisting the action of corrosive liquids is some kind of silicious ceramic material, as this can be obtained in forms which are quite insoluble in almost any liquid. Ceramic material is also of a very hard nature, so that it is practically unaffected by erosion. Hence, in spite of its somewhat unsatisfactory mechanical properties, it has been brought into use for many purposes. A new acid-ware, called ceratherm, was prepared during the war under the necessity of finding some substance suitable for apparatus for the condensation of large quantities of acid gas. Like silica-ware, it can be plunged when red hot into cold water without cracking, and its good heat conductivity permits of a rapid equalization of temperature in vessels of which it is made.

A modified form of ceratherm, having a higher tensile strength, and possessing the further advantage of being more easily manufactured to accurate dimensions, has been adopted by Guthrie & Co., of Accrington, England, in the manufacture of their acid-proof pumps and other articles. The material is entirely unaffected by almost every chemical solution and may be brought into contact suddenly with either hot or cold liquid without any danger of cracking.

The requirements of the chemical industry usually call for a pump designed for lifting comparatively small quantities, say, from 20 gallons to 100 gallons per minute, against a head of anything up to 120 feet. Comparatively high efficiencies are claimed for these pumps, although when the total power absorbed is so small, the question of efficiency would not seem a serious matter. Pumps in this class have been built for a head of 300 feet, which corresponds to a pressure of 130 pounds per square inch in the pump casing. Some pumps have been constructed to deliver 400 gallons per minute at a head of 90 feet when running at 1000 revolutions per minute. They have been used successfully for some years on a commercial scale for pumping sodium peroxide, both hot and cold solutions, a substance which is very troublesome to pump and for which a metallic pump would be useless as the slightest particle of metal passing into the process would do considerable damage. There are other liquids such as hydrochloric, nitric and acetic acids, both hot and cold, that are also being handled successfully by pumps of this type.

* * *

DEVELOPMENT OF AUSTRALIAN INDUSTRIES DURING THE WAR

Many new industries were started in Australia during the war, mainly because it was found difficult to obtain many manufactured products from England or America. Among the industries in the metal-working field developed at this time may be noted those engaged in the making of copper tubes, sheet copper, cotton insulated electric wire, steel wire and bars, electrolytic zinc, non-ferrous castings, locomotive tires, and automobile bodies.

For many years prior to the war the iron and steel industries in Australia had been encouraged by means of subsidies from the government, but this plan met with only limited success. During the war, however, steel works were established in New South Wales. Largely due to the operation of these works, the value of iron and steel products imported in the form of pig iron, structural rolled steel shapes, girders, plates and sheets, and wire and rails was reduced from over £6,000,000 in 1913 to less than £3,000,000 in 1918. As a matter of fact, the tonnage imports decreased in even a larger ratio than is indicated by these figures, because of the large increase in prices during the period covered by these figures.

The Australian tariff policy, never too liberal, will in the future probably be still more centered upon protecting the industries started or expanded during the war, with the view that all Australian requirements, as far as possible, may be filled by Australian mills and factories. This applies especially to those industries the raw materials of which are available and produced in Australia.

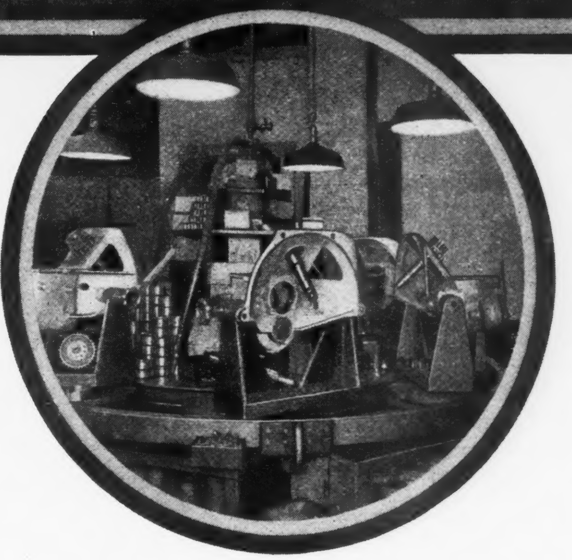
* * *

RULES FOR HANDLING DIE-BLOCKS

The following rules for the handling of die-blocks are given by the Pennsylvania Forge Co., Bridesburg, Philadelphia, Pa., in a recent publication entitled "Die-blocks":

1. Never harden a block unless the impression has been carefully polished. Rough impressions are the cause of many failures.
2. Never charge cold blocks into a hot furnace.
3. Never rush heating operations. Take plenty of time and save trouble.
4. Never quench a block that shows uneven heating. If properly "soaked," the color and temperature will be the same throughout.
5. Never allow a block to become dead cold in the bath.
6. Never postpone the drawing of a die-block. Draw it immediately after hardening.
7. Drop-forging dies should never be stored in a cold, drafty place after hardening.

Machining Aluminum Automobile Parts



ON account of its lightness and other desirable physical properties, aluminum is finding a steadily increasing field of application in the construction of machine parts. For this reason, information concerning the most advanced practice in machining aluminum is a matter of considerable importance to men who are called upon to specify the methods of performing manufacturing operations. One point which is sometimes overlooked while deciding upon the conditions under which machining operations are to be performed on pieces made of this metal is that it can be cut at very high speeds. In planning all classes of machining operations on production work, the selection of the most desirable cutting speed should be based upon the attainment of the highest rate of output that is consistent with the frequency with which tools have to be ground. If a high rate is attained at the expense of excessive tool grinding, the advantage may be more than offset; and similarly, cutting tools may be protected from wear at the expense of production. The most satisfactory method of procedure is to secure a balance between these two factors, but in machining aluminum, speeds that would be too high in cutting almost any other commonly used metal can be successfully employed.

In constructing the Essex car, built by the Hudson Motor Car Co. of Detroit, Mich., the transmission case is made of aluminum having a minimum tensile strength of 16,000 pounds per square inch, with a minimum elongation of 1.5 per cent in two inches. In the accompanying operation sheets, information is given in regard to the order in which machine work is done on these parts. For each operation the cutting speed is tabulated, and reference to these data will be of interest to men who have occasion to recommend cutting speeds for use on aluminum, as it will serve to indicate the speeds under which representative machining operations can be performed on this metal. However, it must be borne in mind that in this case, as in all others where speeds and feeds are recommended, such suggestions serve only as a starting point in ascertaining what rates are best adapted to the requirements of existing conditions on each job. It is only by taking the average figures and then experimenting with rates above and below them, that the ideal conditions of speed and feed can be determined.

Machining Operations on the Essex Transmission Case

Fig. 1 shows the Essex transmission case, and in Table 1 there is presented complete information concerning the machining operations performed on this piece. On these parts

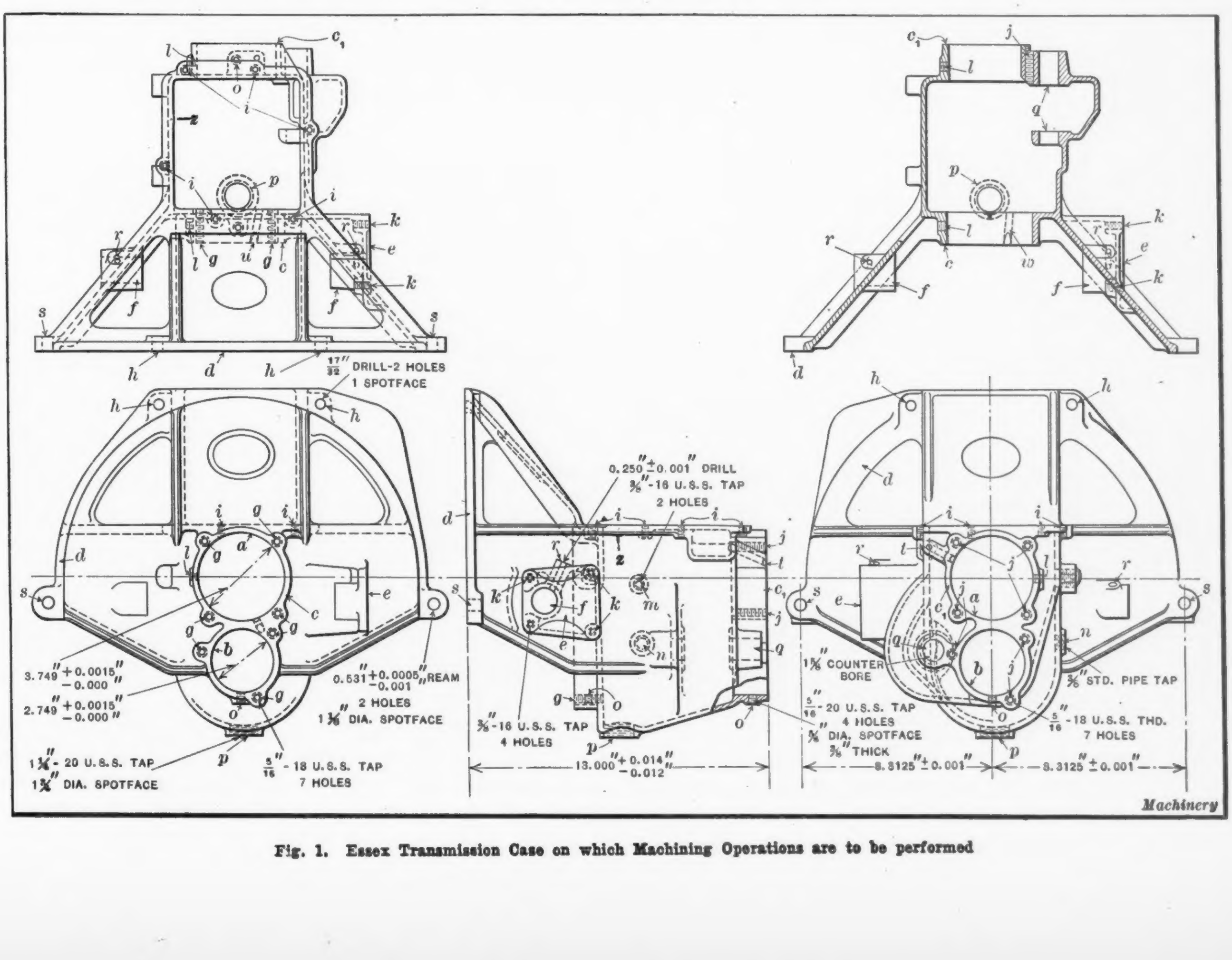


Fig. 1. Essex Transmission Case on which Machining Operations are to be performed

there are a number of operations which are of interest, owing to the jigs or other special tools that are employed on standard machines, or on account of the necessity of building special machines to afford an ideal method of handling the work. As an example of one of these special equipments, the reader's attention is directed to Fig. 2, which illustrates a special Barnes four-spindle horizontal boring and reaming machine that is utilized for operation in the main bearing *a* and countershaft bearing *b*, Fig. 1. On the bed of this machine there is a block that carries two finished pads, one of which is shown at *A*, Fig. 2. These pads engage a previously milled cover face *z* on the transmission case and afford a preliminary location. There are two V-blocks *B* carried by the pivoted cover *C*, which come down on the outside of cylindrical surfaces on the transmission case to provide for clamping it in place.

To facilitate operating the machine, it will be noticed that counterweights are provided at the back of the cover plate, so that when the latch *E* is turned to allow it to slide through a slot in the cover, these counterweights raise the plate without requiring the expenditure of physical effort by the workman. After a fresh casting has been put in the jig and the cover has been pulled down and secured by latch *E*,

TABLE 1. ORDER OF MACHINING OPERATIONS ON ALUMINUM CASES

Oper. No.	Name of Operation	Type of Equipment	Cut. Speed Feet per Min.	Prod. Time, Minutes
1	Rough-inspect	Bench	....	....
2	Mill face z, Fig. 1; bore bearings a and b	"Milwaukee" vertical miller and Barnes horizontal boring mill	420 and 175	5.91
3	Hand-ream bearings a	Stand and work-holding fixture	....	1.64
4	Mill front and rear bearing faces c and c_1	"Milwaukee" vertical miller	471	5.58
5	Mill front flange d	Special milling machine	576	2.42
6	Mill bracket e	Toledo hand miller	419	2.43
7	Drill and ream bearing f	Aurora drilling machine	103	3.05
8	Inspect	Bench	....	....
9	Drill seven holes g, two holes h, six holes i, and seven holes j	Baush multiple drilling machine	302, 101 and 98	3.65
10	Drill four holes k, two holes l, two holes m, and one hole n	Baush multiple drilling machine	100	3.35
11	Drill two holes o; drill, spot-face, and tap hole p; and drill and ream holes q	Aurora vertical and Carlton radial drilling machine	220 and 90	4.53
12	Spot-face, countersink and tap two holes l; spot-face two holes m; countersink and tap six holes i; spot-face, countersink, and tap two holes o; and spot-face holes f	Carlton radial drilling machine	104, 230 and 270	3.43
13	Countersink and tap seven holes g, seven holes j, two holes m, one hole n, and four holes k	Carlton radial drilling machine	145, 123 and 104	3.20
14	Drill two holes r	Kokomo drilling machine	114	0.55
15	Spot-face bearing q to length	Kokomo drilling machine	178	2.75
16	Drill holes t and w	Carlton radial drilling machine	190	0.92
17	Hand-ream bearings a and f	Stand and work-holding fixture	....	2.04
18	Line-ream bearings b and q	Stand and work-holding fixture	....	3.20
19	Finish-mill flange d	Special milling machine	336	2.60
20	Drill and ream holes s	Sipp sensitive drilling machine	134	1.85
21	Spot-face four bosses h and s	Sipp sensitive drilling machine	256	0.73
22	Press bushings in holes f	Greenerd arbor press	....	0.73
23	Line-ream bearing f	Bench and work-holding fixture	....	1.73
24	Wash and remove burrs from bosses m	Tank	....	0.35
25	Solder defects in castings	Soldering copper	....	....
26	Inspect	Bench	....	....

Machinery

TABLE 2. ORDER OF MACHINING OPERATIONS ON LYNITE PISTONS

Oper. No.	Name of Operation	Type of Equipment	Cut. Speed Feet per Min.	Prod. Time, Minutes
1	Inspect	Bench	....	....
2	Bore, face, and chamfer skirt a, Fig. 5	Warner & Swasey turret lathe	750	0.80
3	Center boss b and face end c	Warner & Swasey turret lathe	880	0.48
4	Turn outside diameter d and rough out grooves e	Porter-Cable short-bed lathe	435	0.93
5	Finish ring grooves e	Porter-Cable short-bed lathe	287	0.98
6	Drill, bore, and ream wrist-pin holes f and cut oil-grooves	Warner & Swasey turret lathe	150	1.6
7	Mill faces g	Briggs milling machine	245	0.30
8	Chamfer face h	Burke milling machine	120	0.42
9	Drill two oil-holes in face h	Leland-Gifford drilling machine	60	0.63
10	Chamfer wrist-pin holes at i	Sipp drilling machine	200	0.22
11	Drill four oil-holes j	Sipp drilling machine	40	0.27
12	Mill oil-grooves in wrist-pin holes f	Sipp drilling machine	160	0.34
13	Grind clearance k	Landis grinding machine	5700	0.56
14	Rough- and finish-grind outside diameter d and clearance on lands l and m	Special grinding machine	5700	1.34
15	Finish-face surface c	Porter-Cable short-bed lathe	1060	0.70
16	Remove center boss b	Sipp drilling machine	275	0.28
17	Broach wrist-pin hole f	Atlas arbor press	....	0.55
18	Hand-ream wrist-pin hole f	Bench and work-holding fixture	....	0.77
19	Mark center line on face c	Bench and gage	....	0.15
20	Wash and dry	Tank and cloths	....	0.10
21	Final inspection	Bench	....	....

Machinery

clamping of the work is accomplished by tightening a T-head bolt *F*. So far as the actual machining operations performed in the main and countershaft bearings are concerned, there is nothing of exceptional interest. It will be seen that there are two opposed spindles at each end of the machine, which provide for simultaneous operation in all four bearings, and it is this provision for handling all of the operations at the same time that is the point of exceptional interest on this job, as it not only saves time but also assures having the bearings bored in accurate alignment, which is a point of vital importance.

Milling the Bearing Faces

In Fig. 3 there is illustrated a vertical-spindle Milwaukee milling machine which is employed for milling the front and rear faces *c* and c_1, Fig. 1, of the main and countershaft bearings. The feature of this job is the provision that has been made for milling both ends of the bearings on a single machine by providing two work-holding fixtures. The fixtures utilized for this purpose are of quite simple design, consisting of two pilots that enter the main and countershaft bearing holes at *A* and *B* to provide for locating the work, these holes having already been bored so that they are available for use as accurate locating points. It will be apparent that the fixtures are so arranged that the front and rear surfaces of the bearings on the two castings are held at the same level, thus enabling a single milling cutter to be brought easily into engagement with the second piece of work after it has completed its operation on the first piece of work.

Very little pressure is required to hold the castings for performing these milling operations, as the thrust is downward; but on the left-hand fixture it will be seen that a hold-down bar *C* is provided, which is slipped into a hole in the base of the fixture with the bar in engagement with the lower side of a square opening in the transmission case. On the right-hand fixture, there is a clamping member *D* which enters the same opening as bar *C*; but clamp *D* is made of sufficient width so that it extends practically the entire

distance across the opening in the casting. With a duplex work-holding fixture of this kind, the milling machine operator is kept constantly employed, because while the cut is being taken on a casting held in one fixture he is able to occupy his time by removing the milled casting from the other fixture and setting up a new piece in its place. It will be obvious that with this arrangement a great saving in time is effected.

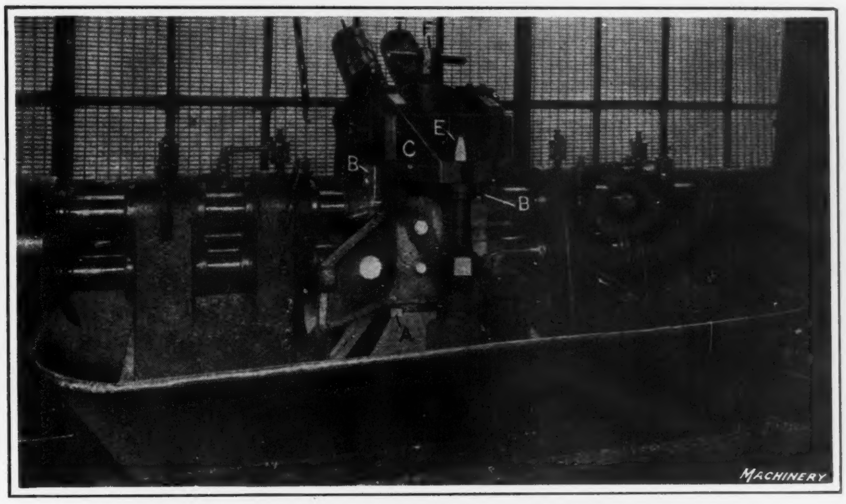


Fig. 2. Special Quadruple Opposed-spindle Machine for boring the Main Shaft and Countershaft Bearings in Essex Transmission Cases

Flange Milling Operation

Fig. 4 shows a special milling machine developed for use in facing off flange *d*, Fig. 1, of the Essex transmission case. For the performance of this job, the main bearing is again used as a locating point for the work, which is secured on a pilot *A* entering this bored hole. As there is but a single milling cutter *B* which occupies a fixed position on the machine, it will be evident that provision must be made for feeding the work to the cutter. This result is accomplished by having the arbor that carries the transmission case casting so located in relation to the cutter-arbor that by rotating the work-holding arbor by means of a handle *C* at the rear of the machine, provision is made for swinging the flange of the casting over the cutter *B*, and thus facing it off in the desired manner. This arrangement constitutes a very simple and at the same time, a very rapid method of performing the required milling operation.

Assembling the Transmission Case

The progressive principle is applied in assembling Essex transmission cases, but the arrangement of the work-benches utilized for this purpose is somewhat different from that commonly employed. Reference to Fig. 6 will make it apparent that the benches are of circular form, instead of being straight, which is the more common arrangement. There is a circular track running around each bench on which work-holding fixtures are free to travel, the transmission case casting being so mounted on its fixture that it may be swung into almost any desired position to give convenient access to the particular point at which a part of the mechanism must be attached. Contained in cabinets beneath the level of the bench, and also in bins on the pyramid shaped stand above the bench, there are supplies of the various parts that must be assembled into the transmission. Following the usual practice in progressive assembling, the men are stationed around these circular benches so that as soon as one man has completed his part of the work, he pushes the fixture along to the operator working next to him, so that this man may proceed to do his part and then push the partial assembly along to the next man in the line. The particular feature of these circular benches is that for conditions that exist in the Essex shops, it is more convenient to employ them than to adopt the use of long straight benches. Doubtless the same arrangement could be employed in the assembling departments of many other plants with equally successful results.

Machining the Essex Piston

Essex engines are furnished with pistons made of lynite which is essentially the same as aluminum, so that the previous remarks relative to progressive practice in performing machining operations on parts made of aluminum applies with equal force in the case of lynite which is finding general application in metal products where a combination of strength and lightness is required. Fig. 5 illustrates the Essex piston, and in Fig. 7 there is shown a close-up view

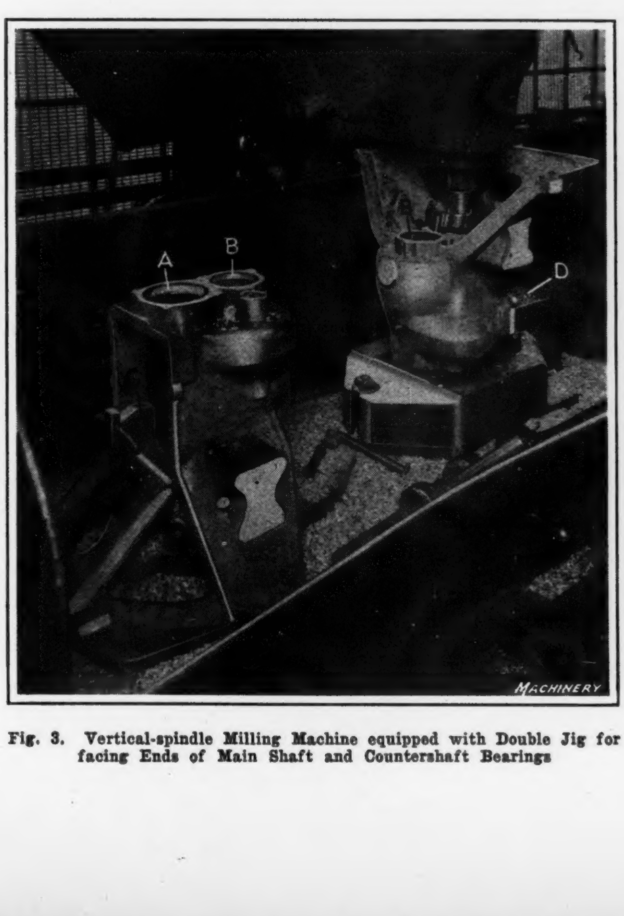


Fig. 3. Vertical-spindle Milling Machine equipped with Double Jig for facing Ends of Main Shaft and Countershaft Bearings

Fig. 4. Special Rotary-feed Milling Machine designed and built for Use in facing the Flange of Essex Transmission Cases

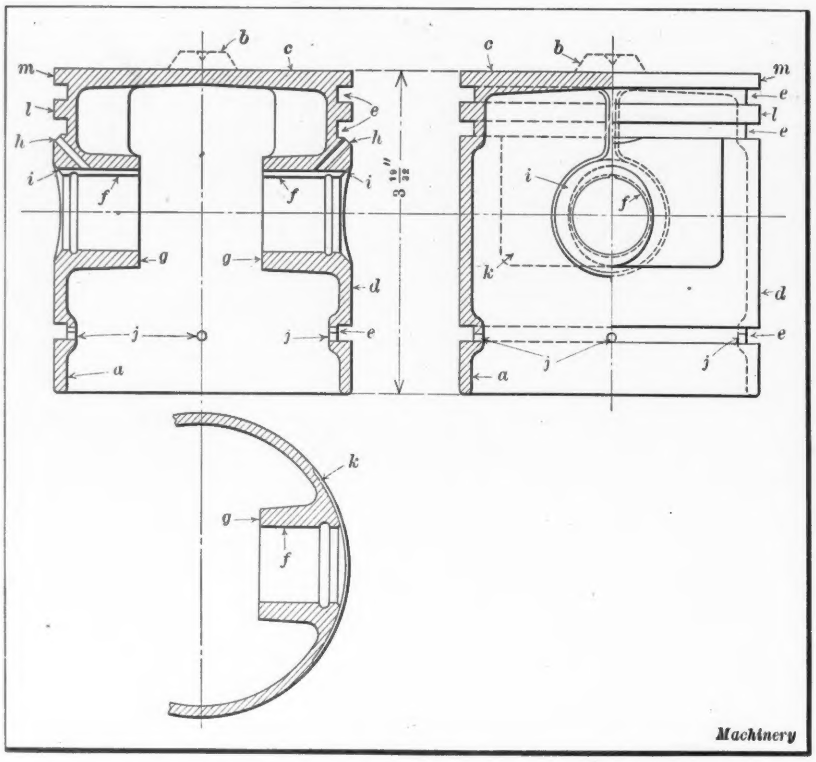


Fig. 5. Essex Piston on which Machining Operations are to be performed

of a Porter-Cable short-bed lathe which is equipped for cutting the ring grooves in the piston and for turning the outside diameter. Lathes of this kind are especially well adapted for performing operations on such parts as motor car engine pistons, because the work is of small size, and ample capacity is provided on a short-bed lathe, without taking up an unnecessary amount of floor space in the shop. In the case of the machine shown in Fig. 7, the three tools *A* carried at the back of the cross-slide are utilized for rough-turning the piston ring grooves, and tool *B* at the front of the carriage is employed for rough-turning the outside diameter of the piston. At the front end of the piston, the work is supported by an ordinary lathe center which enters a hole drilled in boss *C* that is left on the piston for that purpose. At the opposite end there is a special center *D* that is mounted on the lathe spindle to provide for entering the bored skirt of the piston, shown at *a* in Fig. 5.

Drilling Two Oil-holes

Reference to Fig. 5 will make it apparent that two oil-holes *h* are drilled diagonally from the middle ring groove into the bearing holes for the wrist-pin. Fig. 8 shows a Leland-Gifford sensitive drilling machine equipped for the performance of this operation. From Table 2 it will be seen that the first step is to bore out the skirt of the piston at *a*, and that this point is used for location in performing many of the subsequent operations. In providing for drilling the wrist-pin oil-holes, there is a pilot extension on disk *A* which fits into the bored skirt, and a smaller pilot that extends up into the piston with a hole in it through which pin *B* can be slipped. This pin also extends through the wrist-pin holes in the piston and provides for clamping the work by tightening screw *C*, which draws the arbor and pin *B* in toward the base of the fixture. The arbor is splined so that it cannot turn, and pin *B* serves the additional purpose of locating the oil-holes to be drilled in the proper relation to the wrist-pin bearings. It will be obvious that the drill bushing is located at *D*, and after one of the two holes *h*, Fig. 5, has been drilled, the work is released from the fixture and reset at 180 degrees from its first position, ready for drilling the second hole.

Grinding Clearance on Pistons

It is required to grind a clearance of from 0.010 to 0.015 inch under the gliding surface of the piston adjacent to each end of the wrist-pin bearings, and for that purpose use is made of a Landis cylindrical grinding machine. The form of the clearance to be ground is clearly indicated at *k* in Fig. 5. For the performance of this operation, the work is mounted in a manner quite similar to that employed on the Porter-Cable lathe shown in Fig. 7, an ordinary center *A*, Fig. 9, being utilized at one end, while a special center

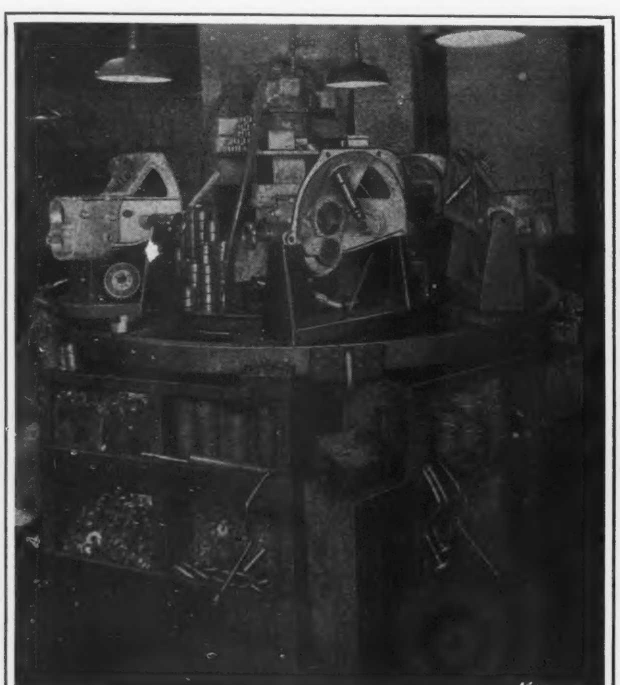


Fig. 6. Progressive Assembling Bench that carries Fixtures around a Circular Path where Parts to be assembled are distributed

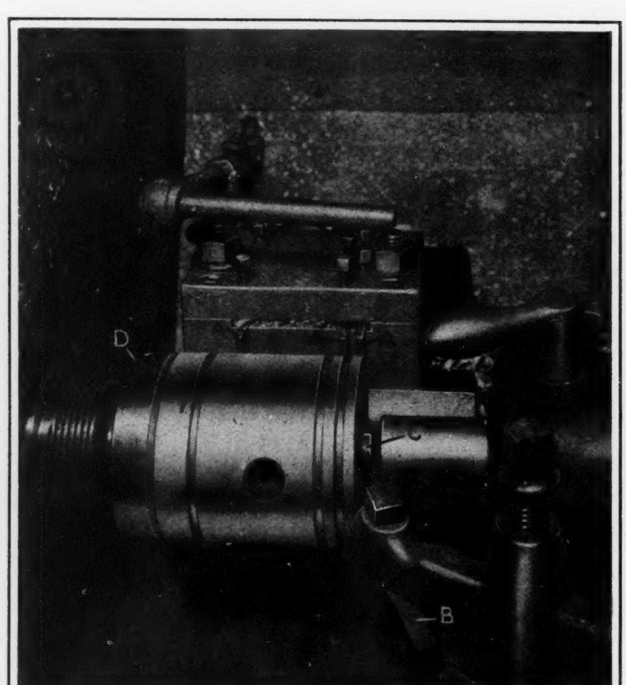


Fig. 7. Turning the Outside Diameter and roughing out the Ring Grooves of Essex Pistons on a Short-bed Manufacturing Lathe

Fig. 8. Jig for drilling Two Inclined Oil-holes leading to Wrist-pin Bearings

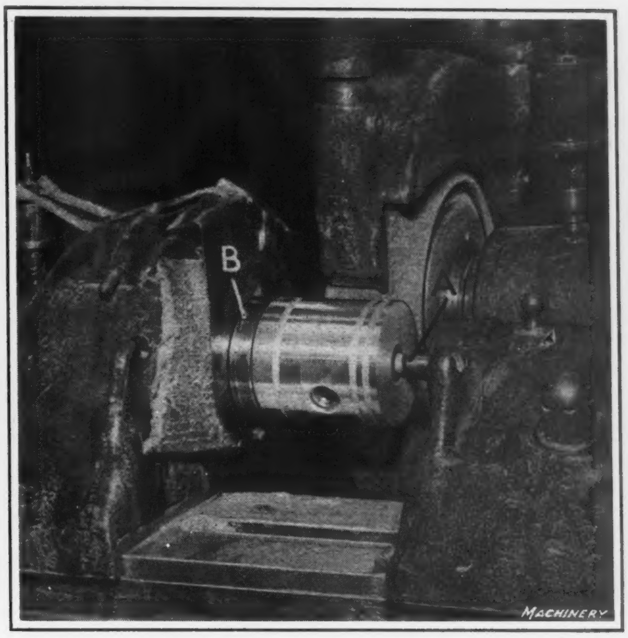


Fig. 9. Cylindrical Grinding Machine equipped for grinding the Clearance on Essex Pistons

B at the other end enters the finished opening *a*, Fig. 5, at the base of the skirt.

Conclusion

On account of the fact that this article deals with the machining of motor car parts, it may appear that it should prove of the greatest interest to those engaged in automobile manufacture; but it may be pointed out that the information contained in this article, relating to the conditions under which aluminum may be machined, is applicable to any industry where aluminum is employed, and will prove of value not only to those engaged in automobile building, but to all readers who have not had much experience in the machining of aluminum.

* * *

MACHINE FOR LAPPING MULTIPLE WORMS

The accompanying illustration shows two special machines built by the De Laval Separator Co., Poughkeepsie, N. Y., for the purpose of lapping the threads of the multiple-threaded worms carried on the vertical spindle which drives the cream separator bowl. The worms, shown at *A* in the illustration, are integral with the steel shaft, and have seven threads. The lap employed is a phosphor-bronze worm-wheel *B*, exactly like the wheel with which the worm threads mesh when in service on the cream separator. These improvised laps are mounted on a driving shaft *C* which is gear-driven for the purpose of stepping up the speed to approximately the amount that is used on the cream separator, that is, from 6000 to 9000 revolutions per minute.

The worms to be lapped, run in mesh with the lapping wheel. One of these worms is held vertically on centers at each side of the wheel as clearly shown in the illustration. The driving shaft has a bearing in the slide *D* to which a vertical reciprocating motion is imparted by means of a cam attached to the inside of the driving gear on the back of the machine. A trundle roll, located below the slide, supports this member by reason of its contact with the cam, so that as the cam revolves with the driving gear, the entire unit, slide, gear, cam, and lapping wheel, is raised and lowered. A suitable coil spring is employed to maintain contact between the roller and the cam. As the revolving worm-wheel lap is traversed up and down in mesh with the threads of the two worms, which are held in a fixed position, it carries a liberal mixture of oil and four-minute carborundum in its teeth. It will be apparent that this lapping compound is carried in trough *E* and that the worm-wheel picks up the mixture as it revolves. The action of the worms and wheel under these conditions will result in lapping the worm threads into perfect running engagement with the teeth of the worm-wheel. The time required to lap the threads to the desired degree is approximately three minutes.

In the illustration the machine at the right is shown as it appears when in operation, while in the case of the machine shown at the left, the guards used to enclose the worms and keep the lapping compound confined, are open for the purpose of enabling a clear view of the worms. The guards catch the lapping compound thrown against them so that it will drip down into the supply can *F*. It is the duty of the operator to keep the trough sufficiently filled with the lapping compound taken from a supply can so that the wheel will be submerged a depth equal to at least that of the teeth. F.R.D.

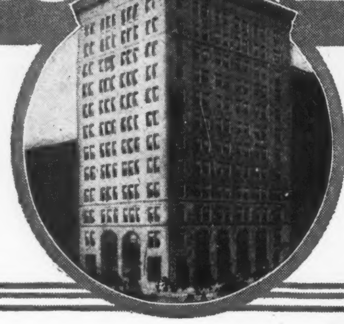
Special Lapping Machine for lapping Threads of Seven-threaded Worm Screws

OCTOBER, 1920 MACHINERY VOL. 27 NO 2

Published Monthly by
THE INDUSTRIAL PRESS
140-148 LAFAYETTE ST.
NEW YORK

ENGLAND
51-52 CHANCERY LANE
LONDON

CABLE ADDRESSES
MACHINERY, NEW YORK
MACHTOOL, LONDON



MACHINERY'S ANNUAL INDEX

The yearly index to the twenty-sixth volume of MACHINERY for September, 1919, to August, 1920, is now ready for distribution. Copies will be sent upon request.

* * *

INCREASED BUYING CAPACITY OF THE RAILROADS

The increased freight and passenger rates which have been granted to railroads by the Interstate Commerce Commission will bring an additional revenue of about $1,400,000,000 or $1,500,000,000 to the railroads annually. The railroads were allowed about 90 per cent of all that they asked for, and it has been determined that with present rates, they will earn approximately 6 per cent on an investment which has been estimated by the Commission at $18,900,000,000. Of the additional revenue that will be earned by the railroads under the new rates, $625,000,000 will go toward the wage advances allowed by the Railway Labor Board a couple of months ago, while the remainder—nearly $1,000,000,000—will add to the purchasing capacity of the railroads and enable them to obtain much needed equipment—locomotives, passenger and freight cars, and more efficient equipment for the railroad shops.

It is expected that the added revenue will enable the railroads to increase their efficiency so that they can cope with the increased demand for freight service—in which respect they failed during the past year. With additional freight cars and increased average car movement per day, in addition to shop facilities that enable the railroads to keep their locomotives and cars in first-class condition, railroad service—both passenger and freight—should greatly improve. Daniel Willard, president of the Baltimore & Ohio Railroad states that the responsibility now rests with the railroad managers. The government has done its part. The improvement, of course, cannot be immediate, but within six months or a year there should be a noticeable change. Meanwhile, the railroad shops will be equipped with modern machine tools enabling them to handle the repair work in a more efficient manner than in the past. This will bring additional business to machine tool builders and will aid in keeping this basic industry busy.

* * *

THE DESIGNER AS A PRODUCER

The designer is often classed as a non-producer in spite of the fact that he may be, and often is, one of the greatest producers in the plant, measured by his ability to increase production. The man running a high-power heavy-duty machine may at the end of the day be able to point to a large pile of finished parts; here we have direct proof of the fact that he is a producer. But the designer cannot readily present such concrete evidence, especially to those unacquainted with his fundamental work. The value of a designer as a producer becomes apparent when we consider the relation the design of the parts of the machine to be built bears to the output. The experienced designer not only considers the intended use of the part and the required strength, but how the casting or forging can be modified to increase production and still serve its intended purpose; it is here that the direct relation between designing and producing is apparent.

The cost of manufacturing is often greatly reduced by simple changes in the general shape of a part, by the use of temporary lugs or flanges for holding it in a chuck or fixture, by the coring of internal grooves and recesses to avoid unnecessary machine work, and so on. While the function of the member and its strength are usually considered first, the designer's work with reference to economical manufacturing practice may be the most important part of his duties. The designer who understands manufacturing practice is often the direct cause of higher rates of production in the machine shop, pattern shop, foundry, and forge shop. When originating jigs, fixtures, dies, special cutting tools, etc., the designer has much to do with the rate of production. Such gains, whether resulting from the design of the product or of special tools used in its manufacture, may in the case of standard parts be effective for years, and represent large dividends on the hours or days spent in perfecting the design. The designer's opportunities as a producer are almost limitless, and his practical value should be measured in terms of the output of both the drafting-room and the shop.

* * *

BUSINESS TRAINING IN ENGINEERING SCHOOLS

Years ago engineering was considered a science that should be kept as far apart as possible from commercial and business considerations. The engineer was supposed merely to develop engineering ideas while others attended to the business problems connected with the engineering undertaking. It was soon found, however, that engineering and business were closely related, especially when the engineer occupied an executive position, and that he should have, in addition to his engineering training, a business training as well. At the present time, therefore, there is a general movement in technical schools and colleges toward the teaching of business administration as well as engineering. Stevens Institute of Technology, one of the pioneers in this development, for over twenty years has given its students instruction in the commercial and business side of engineering. The Massachusetts Institute of Technology has followed with what is probably a still more extensive course in engineering administration, combining instruction in general engineering subjects with a study of the methods, economics, and laws of business.

There will be a greater harmony, economy, and efficiency in the operations of industrial and manufacturing enterprises when engineers have a better conception of business practice, and the engineering schools can render a great service by educating their students in correct conceptions of the relations between business and engineering.

The Industrial Outlook in Europe

By ALEXANDER LUCHARS, Publisher of MACHINERY

THE published views of travelers about European conditions differ as widely as the election prophecies of politicians, and neither the extremely pessimistic nor optimistic statements appear to the writer to be accurate. In some countries, notably Belgium and France, there has been steady industrial improvement during the past year. Labor in those countries has virtually quit striking and gone to work producing. Government employes in France are prohibited from joining the trade unions, and those they have formed have been ordered dissolved. In Great Britain an industrial reaction is in progress and conditions are not so good as in 1919, but they will improve if the coal strike is settled, as many hope. The present set-back should be only temporary. In Germany conditions have lately become decidedly worse; the people are completely discouraged over the outlook and the financial situation appears to be beyond the capacity of the government to handle. In Italy they are approaching chaos on account of the apparent weakness of the government, which lacks sufficient popular support to return the seized factories to their owners.

The first consideration for American manufacturers who are interested as sellers in foreign markets, is whether future European trade is worth fighting for through the uncertain years just ahead. The answer, of course, is that we must either continue to fight for those markets or give them up indefinitely. Foreign markets for machine tools that are lost now, cannot be regained by the easy pre-war efforts when competition from foreign manufacturers was negligible. The fluctuating value of the dollar in Europe is one of the main difficulties of selling American products.

Great Britain

In spite of the overhanging miners' strike and the drop in automotive production, the general feeling is optimistic. Nearly all the engineering establishments are busy. The return of plants to peace conditions has been practically completed, although some concerns like the large armament makers have great difficulty in adapting themselves to new conditions, owing to the nature of their plants.

The Olympia exhibition, organized by the Machine Tool Trades Association, which opened at Olympia early in September, was larger than any similar exhibition ever held in this country. All the space in the great building was occupied by over two hundred exhibitors of machinery. Further details will be found in the article "The Machine Tools at the Olympia Exhibition" on page 123.

Prices of Machine Tools in Great Britain

The average increase in machine tool prices since August, 1919, is about 25 per cent, made necessary by the increased cost of material and labor. British manufacturers do not readily give out their current prices, but the following figures, representing the principal groups of machine tools, are reliable:

	Prices in £'s 1919	Percentage Increase, 1920
Engine lathes, 17-inch swing	160	25
Engine lathes, 12½-inch swing	175	20
Engine lathes, 9-inch swing	80	38
Shaping machine	200	25
Shaping machine	145	10
Horizontal boring and milling	900	15
Radial drilling machine	220	40
Plano-milling machine	900	15

The following are specific merchants' quotations for new tools:

Pickersgill 20-inch swing by 10-ft. bed gap lathe	£275
Cunliffe & Coom 6-inch slotter	110
Gridley 2¼-inch, four-spindle automatic	800
Vertical miller, Smith & Coventry, Model C	920
13-inch swing Yorkshire lathe with chuck	100
Pedestal drilling machine, 1¼-inch capacity	58

Examples of recent quotations for imported German machines are as follows:

Single-spindle ball bearing sensitive drilling machine, drilling up to 13/16-inch diameter..................£38, 10s.
20-inch swing lathe, Hendey type, with 4-ft. 6-inch bed, £320.
Universal milling machine with table 33 by 9 inches, £330.

Government machine tool sales have dropped off, although the distribution of such tools did not apparently lessen purchases from the makers. Rather, this source of supply proved of use in reconstruction work, as such tools were available for immediate delivery following the war and helped production at that time. The prices obtained at some of these sales exceeded those for new tools, or tools "re-conditioned" by the manufacturers. At a recent government sale several 15-inch swing all-geared lathes brought £210 each, average; the same tools were offered new at £175.

Labor and Wages in Great Britain

A comparison between labor costs in Great Britain and America is of special interest to our manufacturers, as that determines our ability to sell our products abroad in competition with British manufacturers.

In the engineering and shipbuilding trades, wage advances over pre-war rates amounted to 3s. 6d at the end of February last for men on time rates, together with a bonus of 12½ per cent on total earnings; and for men on piece work a general advance amounting to 26s. 6d per week, together with 10 per cent on pre-war prices and a bonus of 7½ per cent on total earnings. In March last a further advance of 6s. on the base rates, with a corresponding advance to piece workers was awarded by the Industrial Court. Thus a turner's average wage has increased from 36s. in 1914 to 64s. 6d, plus 12½ per cent in 1919, and today is 75s. 6d, plus 12½ per cent. The system of payment by results does not appear to make much headway.

France

The sale of new American machine tools is almost at a standstill in France, but a fair business is being done in small tools and considerable in second-hands. Few German machine tools are being sold on account of advanced prices and delay in deliveries, but German small tools are now coming in. Before the war some of those compared favorably with American products.

The French automobile manufacturing industry has recently undergone a severe setback, most of the largest works having cut down their output.

French manufactures and exports have so increased in volume that as soon as raw material is available the industrial future appears secure. On July 1, 1920, nearly 77 per cent of the French factories had resumed work, and their output was 65 per cent of the 1914 production, as compared with less than 10 per cent of the same production in July, 1919. French exports for the first 8 months of this year were 14,406,438,000 francs, compared with 5,743,218,000 francs for the corresponding period of last year, and the largest part of this increase was in manufactured products.

Germany

The machine tool business was dull during the spring and summer, with no indication of improvement as autumn approached. Manufacturers had considerable stocks on hand for prompt delivery, but domestic prices were firm, as there was no prospect of a reduction in labor or other costs. The official prices for exports have been reduced, but this has not stimulated sales. Some manufacturers in the automotive and other machinery industries have been running on half time since August, with a considerable reduction in the number of hands employed. Industrial conditions generally are worse than a year ago.

Spain and Italy

Machine tool business was fairly good in Spain earlier in the year, but recently has fallen off and lately few orders were being placed. This market, although a limited one, should increase to a moderate extent and warrant cultivation by American manufacturers of machine tools that can be sold in competition with European products.

Italy has an abundance of labor, and in the early summer was making fair progress toward industrial recovery, when the Mechanics' Labor Federation demanded a further increase of 60 per cent in wages. The refusal of the Master Mechanics Association to grant this increase was followed by the seizure of factories in the metal manufacturing districts, and the development of conditions which resembled those of the beginning of the Russian Revolution. Some of the workmen's ideas were represented by the following printed regulations issued in August by their leaders:

1. Production must be reduced to a minimum.
2. Work must be simulated, thus obviating any absurd pretext of the management to resort to dismissal or lock-out.
3. No files or other tools must be used unless they be in perfect order and fully suitable to the job on hand.
4. Every repair to machinery must take the longest possible time.
5. Nobody, and for no reason, must attend to a different job from the one on hand, such as repairs, oiling, etc.

Lastly, should the firm dismiss workmen, these must take no notice of the dismissal, and must continue to re-enter the factory. Should the managers then resort to forcible ejection, the operatives must proceed to violent acts. Should a lock-out be enforced, the works must be re-entered at all costs, even to breaking in.

Some of these read like jokes, but they are not.

Switzerland

The eight-hour day has brought a considerable increase in the cost of manufacture and has also affected the prices at which Swiss products are sold. The Swiss watch-making industry is not yet selling its normal product on account of the financial conditions in the usual markets. Most watch manufacturers are running on reduced schedule, some as little as three days a week. There is a fair demand for American machine tools, but this has been somewhat affected lately by the efforts of a group of Swedish manufacturers, called the Swedish Machine Tool Makers' Export Co., Ltd., of Stockholm, which has been making a canvass of Swiss factories for possible customers.

During the year 1919, and especially during the latter months of that year, the Swiss bought considerable amounts of German machine tools, but the increase in prices and the delay and uncertainty of delivery since the beginning of 1920 has largely cut down the sales. Swiss buyers say that German machine tools are not up to their pre-war standard.

Sweden, Norway and Denmark

The rate of exchange for dollars makes it impossible to buy American tools except for special work and such tools as cannot be obtained elsewhere, and manufacturers are trying to get along with Scandinavian tools, waiting for the rate of exchange to become more reasonable. During the war a number of Scandinavian manufacturers took up the manufacture of machine tools and are now making fairly good machines at a lower price than the American product. The increase in the prices of German tools has affected their purchase and comparatively few are now coming into Scandinavia. Although the general industrial situation there is similar to that prevailing all over Europe, the better dealers do not feel discouraged over the future.

During 1919 German machine tools were offered in Sweden so cheaply that many of the large manufacturers anticipated future machine tool demands by buying for the equipment of plants not yet in operation. A concise but comprehensive review of the present conditions in the Swedish machine tool industry was given in the article by Oscar Lindbom in the August number of MACHINERY, page 1130.

Belgium

The production and sale of Belgian manufactures continues to increase phenomenally, the total exports for the first five months of 1920 being nearly fifteen times those of the same period of 1919. The general industrial situation in Belgium continues favorable, many shops having work for months ahead. Lately, however, orders have dropped off, due perhaps to the confused political outlook or to the curtailment of banking facilities.

Some dealers complain that the delay in deliveries of American tools caused by strikes here will help the sale of German tools in that market. The larger and better known concerns are not buying in Germany unless they cannot get machines elsewhere. Most of such purchases are made by small and unimportant firms.

Russia

In response to numerous inquiries about conditions in Russia and the outlook there, I obtained information from several reliable sources up to as late as August last.

General conditions have been correctly described by correspondents of American journals who have been permitted to see the favorable side. One of my correspondents is an Austrian engineer who was a prisoner in Russia for four years, and after his release visited Petrograd, Moscow, and other industrial centers. He said that all railroad shops, machine shops and factories, including those belonging to foreigners, are now owned, and some of them operated, by the state and managed by commissars. Terror is the factor used for control. No commissar can tell when he may be removed by a meeting of workmen or by some remote authority above him. The legal day is supposed to be eight hours, but men work from two to four hours, spending the remaining time in smoking, talking and political discussion. The wages in machine shops vary. In Petrograd and Moscow from 4000 to 6000 rubles a month are paid; in Siberia from 1500 to 2000. There is no such thing as liberty in Russia, but there is deep and widespread dissatisfaction with Bolshevism, although no one dares to say a word against it for fear of being put in prison or shot.

The most primitive methods prevail in what machine shops are running, each commissar working according to his own ideas. Material is almost unobtainable, and that is not to be wondered at, because it is not usually paid for. The shop equipment is, to quote, "in awful condition," and most of the small tools have been stolen. About 80 per cent of the locomotives are "sick," and are to be seen stalled along the railroads. Traveling is almost impossible even if a ticket is obtained, and only commissars can obtain them. Others wait for weeks unless they pay someone with influence to get a ticket for them. The most rabid Bolsheviks are now turning against the present tyrannies, and if an organized movement of the people were possible, or a series of victories gained by an outside army, the present rulers would quickly disappear.

Machine Tools at the Olympia Exhibition

Editorial Correspondence

London, September 16

THE British exhibition of machine tools and accessories, held at Olympia, near London, in the early part of September, was the great event of the year in the British machine tool industry. One of the main objects of the Machine Tool Trades Association of Great Britain in promoting the exhibition at Olympia—the first to be held since 1912—was to extend the export trade in machine tools. During the war, the machine tool manufacturers were so occupied in satisfying the requirements of munition makers that the overseas markets were neglected, and in fact the Ministry of Munitions would permit the export only of such machine tools as would be likely to help in the production of munitions for allied countries.

In order to bring as many foreign engineers to London as possible, for the exhibition, a widespread scheme of publicity was organized, upward of 12,000 invitations being issued to engineers all over the world. Every inch of the great floor space of the Olympia building was booked, and although new designs were not numerous, the exhibits generally emphasized the point that the importance of mass production has been brought home to the British machine tool industry to an extent which assures buyers of quality and uniformity of production, which have been the chief features of the American competing machines.

Outstanding developments are featured in the exhibits of the Associated British Machine Tool Makers—a group of leading manufacturers who are combined with the express object of promoting and developing standard machine tools. These firms between them cover, as far as customary machine shop requirements are concerned, all the needs for a manufacturing installation. The policy of confining their attention each to one particular branch of the machine tool field has permitted the concentration of accumulated experience to specific essentials. The association is doubtless destined to have a far-reaching effect on the machine tool trade of Great Britain. The constituent firms include such firms as Smith & Coventry, Ltd., Lang & Sons, Ltd., and William Asquith & Co., Ltd., who with other well-known makers are working in a cooperative manner and specializing along individual lines. The exhibit of Alfred Herbert, Ltd., was also very comprehensive. American machines were shown in great numbers, mainly at the stands of the great merchant houses of Burton, Griffiths & Co., Ltd., and Charles Churchill & Co., Ltd., but German machines were rigidly excluded due, not to the fear of German competition, but to the policy that the Machine Tool Association adopted during the war when the exhibition was projected.

New Machine Tools Exhibited

As was to be expected, a great many of the machine tool manufacturers showed new designs at the exhibition. There were a great many radical departures, and many improvements on older types. It would not be possible in the following to mention all the new designs or improvements that were on exhibition, but attention will be called to a few of the more important.

The Alfred Herbert Exhibit

Alfred Herbert, Ltd., Coventry, occupied not less than nine stands. New and redesigned machines included a No. 20 combination turret lathe fitted with a new type of head having a 7-inch hole through the spindle instead of the previous bore of 4½ inches; No. 9 combination turret lathe fitted with quick-power motion to the turret slide, power rotation to the turret, and single-pulley drive; No. 13 hexagon turret lathe with a sixteen-speed headstock; a new No. 5 auto-lathe, which is fully automatic in all operations except chucking, stops automatically at the conclusion of the work, and has automatic speed and feed changes that can be made while the tools are cutting. An outstanding novelty is a 4-foot radial drilling machine built by Tangye's, Ltd., to Herbert designs. The features are an arm of circular section giving a three-point bearing to the saddle, an instantaneous electrical reverse, lubricant circulated by an independent motor, a speed range of from 28 to the unusually high maximum for a machine of this class and size of 547 revolutions per minute. Then there is a new 50-inch broaching machine with two speeds and single-pulley drive; a cold-sawing machine fitted with a chip removing device; a Tangye axle-turning lathe with diameter and longitudinal stops, and a Tangye axle-ending and centering machine, the high productivity of which is aided by such improvements as a constant quick-power traverse to heads and saddles, and an additional tool-rest with automatic feed for turning the axle collars while the tool in the front rest faces the ends. Sample sets of precision sizing blocks are shown, for which the firm is arranging to act as sole distributor for the Pitters Ventilating & Engineering Co., which has taken over the manufacturing rights under the Brookes & Sears patent. The size blocks are accurate to one part in one million in all sizes down to 1 inch, and uniformly to the same accuracy for smaller sizes. Alfred Herbert has now a new gage department, and has introduced an indicating plug gage giving "Not Go" effective diameter readings; and also a universal thread measuring machine giving readings to 0.00001 inch.

Turret Lathes, Screw Machines and Automatics

H. W. Ward & Co., Ltd., Birmingham, have introduced a new 7-inch center all-geared hand screw machine of attractive appearance. The headstock has eight spindle speeds, to each of which reversing motion is applied, and the spindle has a 2⅛-inch bore. A special new patented quick-withdraw motion is included in the cross-slide, whereby the nut is withdrawn from the work. The turret is of the usual form, but has ten automatic feeds which are entirely independent of those of the cross-slide. The firm's 7-inch center combination turret lathe has many of the features of the foregoing machine, but is capable of dealing with a heavier class of forgings and castings, also bar work up to 18 inches long. The third is of a powerful rigid dual-purpose type, designed for production from the bar, castings, and forgings. The headstock is of the all-geared type, having eight speeds forward and reverse. The spindle has a bore of 4½ inches through its entire length. The turret is of hexagonal form mounted on a saddle having longitudinal motion by hand and power feed along the bed. Ten automatic feeds are available through the gear-box beneath the headstock and these feeds are independent of those of the cross-slide. Quick power traverse and automatic rotation are provided. The cross-slide has hand and automatic motions.

Thomas White & Sons, Ltd., Paisley, have concentrated on a new line of automatic screw machines. Built in three types, the machines comprise a universal machine for average machine shop bar work up to 1 inch or 1¼ inches diameter, and a larger machine for bar work in three sizes from 1½ inches up to 2½ inches diameter, also a special manu-

facturing type of machine for use where a large repetition output is required.

Thomas Ryder & Sons, Ltd., Bolton, exhibited an automatic piston and piston ring manufacturing lathe, which will simultaneously turn, bore, and cut off bushing castings into rings. Concentric or eccentric rings can be produced with equal facility.

Lathes

John Lang & Sons, Ltd., Johnstone, showed a new 6½-inch center automatic screw-cutting lathe. This machine is a new design specially intended for automatically cutting internal and external screw threads. After the lathe has been set up and started, it is entirely automatic in all its operations until the full depth of the thread is reached, when a device comes into operation which limits the movement of the tool-slides and prevents the tools from feeding any deeper into the work.

Drummond Bros., Ltd., Guildford, exhibited, as an entirely new departure, a spiral hob relieving lathe, which is primarily intended for tool-room work in hob and tap making, and similar work of a precision nature. The lead-screw is made to very close precision limits and together with the headstock spindle is hardened and ground.

The Centaur Works showed a 5-inch center brass finishers' lathe. In the automatic turret machine class the Centaur Works also showed a three-operation automatic machine for bars up to ⅝ inch diameter.

Archdale Automatic Milling Machine

James Archdale & Co., Ltd., Birmingham, have introduced a new type of automatic horizontal milling machine especially suitable for quick cutting and rapid handling. The work, after it is secured to the machine table, is quickly carried to the cutters, when the cutting rate of traverse is engaged and the cut proceeds. At the end of the cut the feed is tripped, the cutters are stopped to prevent them marking the work and the table returned quickly to the starting point. The duties of the operator are thus limited to removing finished pieces, chucking new ones, and manipulating a lever.

Stirk Planers

John Stirk & Sons, Ltd., Halifax, exhibited a 5- by 5- by 16-foot planer which embodied an improvement in the Stirk split field drive and is exhibited for the first time. The principal difference over the original Lancashire drive is the Stirk disk and master switch actuating a set of five contactors which constitute the reversing switch proper and take the place of the oil switch. The equipment consists of a motor-generator, a reversing motion, master switch, starter or primary motor, contactor and regulator, and a panel for generator, start, stop and inching buttons. The arrangement permits a quick-return reverse to the table motor, and enables cutting and return speeds to be varied independently.

Smith & Coventry Gear-cutting Machinery

Smith & Coventry, Manchester, showed a new spiral bevel gear planer which is a development of the Robey-Smith bevel gear planing machine, and which is now ready for the market. The dividing movement is made at each reciprocation of the tools as in the Robey-Smith machine, by which the heating of the blank and the wear of the tools are distributed uniformly around the whole wheel, successfully avoiding the trouble often arising of the last tooth being too thick or too thin. While the other spiral bevel machines generally use an empirical curvature of tooth, the present machine produces a correct geometrical spiral; that is, the blank moves at a uniform rate about its axis, in relation to the movement of the tools across its face. By reason of this, one common limitation in the adjustment and use of spiral bevels is eliminated, and more correct action is obtained, the teeth being symmetrical in any surface of revolution about a line in such surface passing through the axis.

Asquith Drilling Machines

William Asquith, Ltd., Halifax, exhibited three entirely new models of radial drilling machines, comprising a five-foot high-speed radial, a portable universal radial, and a ball-bearing girder radial. These machines are intended to meet the demands for a medium size high-speed machine to drill holes of moderate diameter in work which does not call for so heavy a machine as the central thrust type. A novel feature is the triple lock lever, which simultaneously clamps the saddle to the radial arm the radial arm to the sleeve, and the sleeve itself to the internal pillar; thus two operations usually performed separately are synchronized. An improved friction feed device is applied so that the spindle can be adjusted vertically on disengaging, or finely by hand without disengaging. The portable universal radial machine is especially intended for drilling operations which are to be performed on assembled or partly assembled work. The radial arm is built in two sections, one of which is fitted to the column and is provided with a horizontal slide to carry the other portion; thus vertical and horizontal adjustments of the drill spindle may be made. The radial arm will also swing through a complete arc around the column and has a tilting motion by hand through an arc of about 30 degrees. The drilling head is so arranged as to swivel to any angle, either horizontally or vertically.

Grinding Machines

Jones & Shipman, Ltd., Leicester, are developing a fine range of grinding machines and equipment. The new 24- by 12-inch internal and external grinding machine is a type suitable for all kinds of cylindrical work, external and internal, parallel or taper, with a capacity of 24 inches between centers by 12 inches swing. There are eight variations of table travel, and automatic sizing is obtainable on the machine. A very fine range of super-high-speed spindles, designed to run at speeds of from 5000 to 100,000 revolutions per minute, is available for the internal grinding work on this machine, so that every possible requirement in fine internal precision grinding can be met within the limits of the capacity of the machine.

Herbert Hunt & Sons, Old Trafford, exhibited a new twist-drill point sharpening and thinning machine. The principle upon which the machine is designed is to revolve the drill continuously in one direction. The amount of clearance to the tops is obtained by imparting a swiveling and a reciprocating motion to the drill-holder slide, through cams and worm-gearing, while at each complete revolution the drill is fed forward a predetermined amount.

Miscellaneous Machines

In vertical boring mills, Webster & Bennett introduce a new type of machine embodying features of interest. The new Dickinson 3½-inch spindle horizontal boring machine, fitted with a facing head is shown by the Atlas Engineering Co. Edward Herbert, Ltd., showed a new gate sawing machine of the radial type for cutting off gates and runners from steel and other castings. The machine will cut through a 24- by 24-inch section at a height of 6 feet from the floor plate. It is fitted with automatic relief by an oil dashpot.

The brief descriptions given deal with some of the more important developments in machine tool design. Although some of the new models may not possess features as fully developed as in certain American models of the same class, there is nevertheless evidence that British makers are fully alive to modern requirements, and noteworthy developments of importance are to be found in the new Herbert No. 5 auto-lathe, the Archdale manufacturing milling machine, and the drilling machine group generally. A new development revealed by the Olympia show was the steel plate frame type of punching and shearing machine introduced by Craig & Donald, Ltd., Johnstone. Such machines, hitherto exclusively German-made, have enjoyed a large popularity in this country.

The Foreign Trade Situation

By W. LaCOSTE NEILSON, Vice-president and Foreign Manager of the Norton Co., Worcester, Mass.

Having lived in Europe since 1909, and having been constantly engaged in commercial affairs in different European countries, W. LaCoste Neilson, vice-president and foreign manager of the Norton Co., who returned from Europe two weeks ago, has had an unusual opportunity to become intimately acquainted with the actual conditions in the European market, and to form an opinion of the prospects of the foreign trade in American machine tools in Europe. The information given in the present article is based upon first-hand knowledge obtained by Mr. Neilson during the last few months, while visiting each of the countries referred to. Mr. Neilson's statements in regard to the foreign exchange prospects and the resumption of a normal foreign trade will be of especial interest to manufacturers.

THE question asked by all exporters of machinery to the European countries is "When will Europe return to normal industrial conditions, and how soon may it be expected that the export trade in machine tools to the European countries will assume normal proportions?" This is a question that is difficult to answer in a few words, or, with any degree of certainty, because the factors involved are numerous, and the conditions in the different European countries vary. At present, as we all know, there is a serious depression in practically every European country. This depression will become more marked all over Europe during the next six months. After that, a gradual normal industrial development will take place. During this development there will be a good demand for American machinery of all kinds, and especially for American machine tools. The demand caused by a normal industrial development will be accentuated by the requirements which will then be pressing for machinery to replace the equipment that has been worn out or become obsolete during the last decade.

In other words, there will be a period during which comparatively few American machine tools will be bought by the European countries, and after that there will be a period when this field promises to furnish a better export market than at any previous time. The present depression may be estimated to last from six months to two years. Subsequently, all industries will again work along normal lines.

When the nations enter upon this new period of reconstruction, the present fluctuations in foreign exchange will become stabilized, but it is believed that there will be an entirely new basis of foreign exchange, and that we will not return to the figures we were in the habit of considering standard previous to the war. There will be new values as to currency between different countries which will be established as new standards. It is not likely that sterling will again be equal to $4.86, or that the franc will be worth 19.3 cents. Speaking in general terms, there are reasons to believe that, as compared with sterling, the dollar will permanently be worth from five to ten per cent more than it was before the war; and as compared with francs and lire, from twenty-five to fifty per cent more. When these new exchange values are established, we will become used to considering these as actual and permanent exchange rates, and foreigners will no longer feel that they are paying more for goods billed in dollars than they ought to pay.

Industrial Conditions in England

The industrial conditions in England depend definitely upon the actions of the labor unions and upon the courage and ability of the Government in dealing with the demands of the unions. A strike on the part of the coal miners in England means the entire tying up of British industries for months. A compromise on the part of the Government with the coal miners does not solve the problem, but merely defers the final clash. In England, more than anywhere else, the unions are in an almost controlling position. But the unions themselves are controlled by a minority, the same as elsewhere, and this minority, in turn, follows blindly a few leaders, who are thus in a position to dictate to the whole labor body. Hence, the steps now planned by the labor unions in England cannot be said to be based upon the concerted action of the whole union membership, but rather upon the passive acquiescence of the membership in the actions and aggressions of their leaders. The whole industrial situation in England hinges upon the coal situation; and a satisfactory solution of this problem, which means a firm stand of the Government, is the only thing that will save the British industries from a very serious depression and many failures.

The financial situation is not satisfactory, and in addition to the attitude of labor and high wages, industry is hampered by high cost of materials and excessive taxes, amounting now to 60 per cent on the excess profits of a business. Most of the older British concerns in the industrial field are financially sound, but it is hard for them to obtain ready cash, and in any transactions with them credit must be extended for a reasonable length of time. The automobile builders are in the most serious financial position, and some of them may not be able to pull through the present crisis. For six months at least, no exports of any account, in machine tools, should be expected to Great Britain.

British machine tool building has been considerably developed during and after the war, and the British are aiming to supply, as far as possible, their own needs in this direction and also to enter into competition with the United States in the world's markets. When the present depression is over, however, the requirements for great additional equipment to replace the old and worn out machinery of British plants will necessitate large imports. The domestic manufacturing facilities will not be able to measure up to the demand. Notwithstanding the present activity in machine tool building in England, the country does not produce a sufficient amount of machine tools to take care of the requirements for the rebuilding of the British industries.

Practically every type of machine tool made in America is now also being built in England; but there are many types, the output of which is insufficient to take care of the normal industrial demands, let alone the unusual requirements that will present themselves when the present depression has passed. It is evident, of course, that meanwhile England will offer a strong competition to American machine tools in the world's markets; but nevertheless, American machine tools will play an important part in the rebuilding of the British industries. Eventually England may supply most of her own needs in this direction, but that time is still quite far off.

Prospects of Foreign Trade with France

France has had less labor troubles, everything considered, than any other country that took part in the world war, except Belgium. The French workmen have settled down and are not likely to cause any trouble that will be of

national importance. In France, the greatest difficulty is credit. There is a potential demand for practically all kinds of American machine tools, but importation of machine tools is extremely difficult on account of the abnormal rate of exchange. In spite of this, there is no evidence of a large development of a machine tool building industry in France. The firms that built machine tools before the war are continuing to do so, but there has not been any unusual expansion in this field. It is likely that the United States will continue to supply the French industries with the bulk of their machine tool requirements, and France will become one of our most important markets. In about two years or so the rate of exchange will become stabilized—at a higher value, to be sure, than before the war—and then the trade with France will probably become greater than ever.

France made many plans during the latter part of the war and during the armistice with a view to building up great industries in fields that had not formerly been highly developed in that country. These plans have not materialized, except on a small scale. France will probably settle down to conditions similar to those previous to the war, and will devote her energies to the building up of the industries that in the past have been pre-eminently French.

Industrial Conditions in Belgium

It is well known that Belgium was recovering more rapidly from the effects of the war than any other of the European countries. At the present time Belgium is experiencing a business depression, the same as the other countries. This depression is in part a reflection of difficulties in adjacent countries and partly the result of financial difficulties. When it appeared that Belgian industries would be readily rehabilitated, confidence was shown in purchasing materials. This led to very considerable purchases, and although it cannot be claimed that an over-expansion resulted, more money was spent in the last year than the financial position justified.

The new confidence that must be acquired before Belgium undertakes serious business will come as a reflection of such new confidence as may be established in other European countries. In the meantime there is no indication of an unusual development in the manufacture in Belgium of machine tools. Although copies have been made of a variety of types of German machine tools, there has apparently been no production on such a scale as to seriously interfere with the prospects of American manufacturers. When business in Belgium speeds up, and this should take place in a year or two, we may look forward to a good normal trade with that country.

Conditions in Italy

As every newspaper reader knows, the industries of Italy are at the moment being seriously injured. The progress which had been made during recent years will be offset, and when the Bolshevism now rampant subsides, more assistance from the outside will be necessary than would have been the case had there been no revolutionary movement.

Italy has had less experience in the production of engineering supplies than any other of the European nations of comparable size, and is therefore less fitted to manufacture modern machine tools. During the war her efforts were confined mostly to the production of war materials, including guns, munitions and ships, and the efforts to manufacture machinery for these and other purposes were almost negligible. It is logical to suppose we will have a good market in Italy when business operations by the business people can be resumed, and when money is available for business. The recovery in Italy may be slower than in adjacent countries because of the weaker position of capital and of those qualified to control operations.

Industrial Conditions in Other European Countries

There has been a development in Scandinavia, especially in Sweden, of natural resources and of industrial capacity along many lines, including machine tools. This naturally will decrease the demand for foreign-made machine tools, although the developments are in large part designed for the export trade to Russia and Germany. When conditions improve, a demand for equipment from foreign sources will result, in order to keep the export industries in operation.

Holland, as all are aware, has increased her trade, but the bulk of it has been an agents' trade, and materials imported have been exported. Holland's exports to her colonies in the Far East will not only continue but will materially increase. In the meantime the manufacturing plants of the country have been stimulated, and in some types of machinery her productive capacity will probably be sufficient to meet her requirements. This (and the fact that Holland will naturally revert to importing German machinery) gives small promise of any appreciable trade for American manufacturers, except in specialties.

The economic and political situation in Germany is so uncertain and the possibilities of failure or success are influenced by so many factors, that it would not be possible to discuss the matter in a brief way. However, one feature of the situation is especially prominent. All industry is being seriously hindered through a shortage of coal. Germany is delivering coal to France and Belgium at the same time that production is below normal owing to the condition of the mines and the labor conditions. There is no immediate prospect of any improvement, and it is impossible to forecast events, industrial or other, in that country.

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ABRIDGED METHOD OF LONG DIVISION

By A. B. SCHLESINGER

In examples containing long division, time can be saved by performing the division as usual for obtaining the first figures of the quotient and then finishing the operation with the slide-rule. This method is much more accurate than using the slide-rule alone and much more rapid than a complete long division.

The rule for this method is as follows: Cut off one figure from the end of the divisor after each regular long division step, and continue until there remain only three figures in the divisor. Use the slide-rule to obtain the quotient when dividing the last remainder by the final three-figure divisor.

Example—Divide 3.1416 by 2.1348

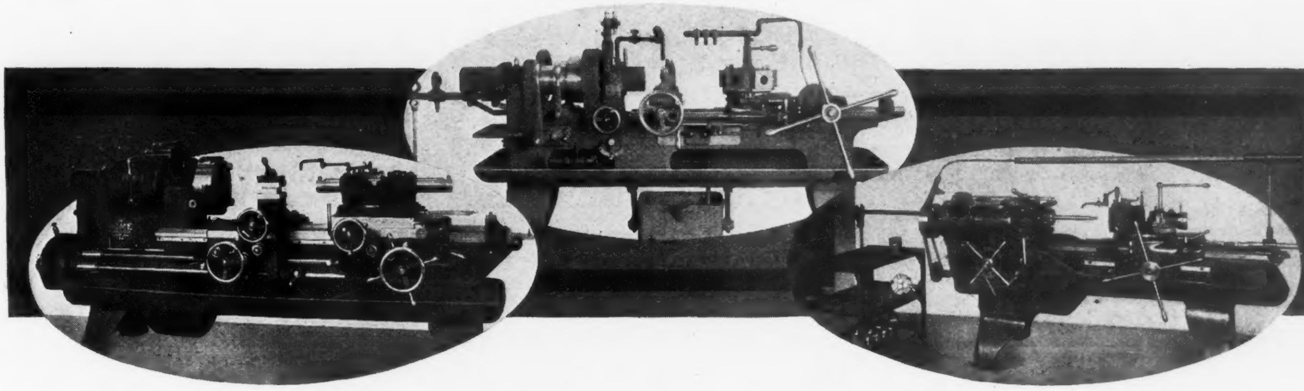
```
21348) 31416 |1
       21348
       -----
2135 ) 10068 |4
        8540
       -----
213  )  1528 = 7.17
```

Dividing the remainder 1528 by the last divisor 213, by use of the slide-rule, the quotient 7.17 (approximately) is obtained. These three figures are the final three in the answer, and the other digits are 1 and 4, as shown in the above computation, so that the result is 1.4717 (approximately).

* * *

INDUSTRIAL DEVELOPMENT IN INDIA

There has been a remarkable industrial development in India during the last few years. During the last financial year, new companies were organized with an aggregate capital of more than $1,000,000,000. In nearly all of these companies both native Indians and Europeans are represented on the boards of directors. As a large part of this new capital must be expended on plant and machinery of various kinds imported from foreign countries, there is a great opportunity for export trade to India. The United States occupies a very strong position in the Indian market, and is second only to Great Britain in the import trade of that country. In the automobile field, the United States has practically a monopoly on the Indian trade. During the past year, out of a total of 9925 motor cars imported, 9353 came from the United States.



Turret Lathe Design and Construction

Important Points Involved in Turret Lathe Design, and Some of the Advantages and Disadvantages of Current Practice

By ARTHUR F. BENNETT

IN the following article the writer proposes to examine some of the features of turret lathe design, confining the observations made to four American and one English machine. These machines are rated as hand screw machines or turret lathes of from 2- to 4½-inch bar capacity, or up to 18 inches chucking capacity.

The Headstock and its Design

The following principles in the design and construction of turret lathe heads have been developed in practice and may be regarded as standard:

1. The work should be held rigidly, and a sufficient number of speed changes should be provided.
2. The various speeds should be in a geometrical ratio, and the ratio should not be greater than 1.5. The speeds should be instantly available, either forward or reverse, without stopping the spindle and without interfering with the other speeds when selecting the one required.
3. There should not be more than two change-speed levers, and these should be so located that they can be easily operated.
4. Fine-pitch gears are desirable because they reduce the noise commonly produced when coarse-pitch gears are used.
5. The transmission shafts should be short and stiff, thereby reducing torsional and bending stresses.
6. Complete automatic lubrication should be provided so as to relieve the operator of this duty and insure satisfactory lubrication of the bearings at all times.
7. The interior mechanism should be accessible, so that replacements and adjustments may be easily and inexpensively made.

Various designs of work-spindle noses are shown in Fig. 1, arranged alphabetically according to their relative merits from the standpoint of effectiveness in attaching the chuck. For the same size machine this depends upon the shape, size, threaded fit, and end abutment. Other things being equal, the largest threaded end, such as shown at *A*, will provide the best joint, the auxiliary fit (also incorporated in designs *B* and *C*) being an additional means of centering. The nose shown at *D* is the simplest and most economical to manufacture. The large sectional view shows in an exaggerated manner the tendency of U. S. form threads on the spindle nose to center the chuck.

Casting the head and body in one piece gives a construction of maximum rigidity and is most generally used. This gives the greatest simplicity from the machinist's point of view and also provides permanent alignment of these two members. However, the Hartness cross-sliding head is a radical departure from the above construction, and is equal in effectiveness to that incorporated in any other turret lathe. In connection with the discussion of head design, it is necessary to observe not only its construction, but also to consider the tool and its substructure. The advantage of the cross-sliding head is the flexibility which it lends to the use of the tools for the purpose of performing facing operations.

Spindle Speeds and Operating Levers

Nine spindle speeds are the minimum and twelve the maximum number in general usage. All makers maintain the geometrical ratio of 1.5. In all cases a separate lever is used for starting, stopping, and reversing the direction of rotation of the work. spindle. It is the author's opinion that too many levers are used in some cases. Means for providing effective speed changes which will operate instantly is a weak point in many heads. There are three speed-changing mechanisms in use (usually in combination with each other), namely, friction clutches, sliding gears, and ratchet and pawl mechanisms. The clutches and the gears are operated

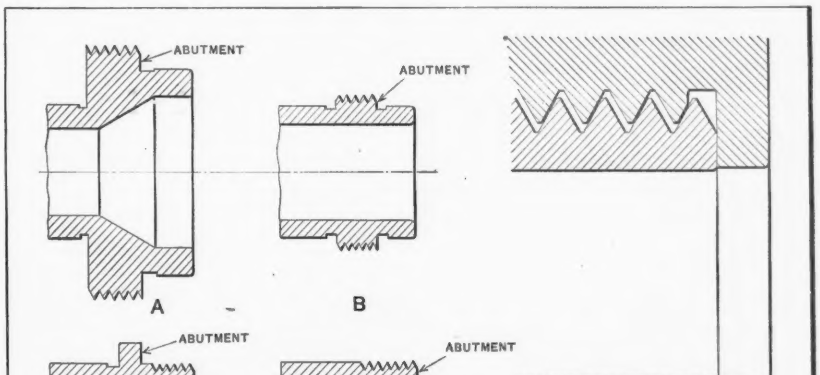


Fig. 1. Designs of Turret Lathe Spindle Noses

by levers conveniently located within reach of the operator, while the rachet and pawl mechanisms are operated automatically by a spring which depends upon friction for operation. Owing to the exacting requirements and heavy duty frequently imposed upon these mechanisms, they often fail to function properly. Friction clutches of the cone type require cams, toggles or wedges to operate them. These clutches are admirably suitable for use on shafts having low torsional stresses, but become expensive and large on spindles (such as work-spindles) that are subject to high torsional stresses—otherwise these clutches are compact and simple.

Sliding Gears

Sliding gears of chrome-nickel steel are giving very good service in machine tools as well as in automobile transmissions. They are simple and make a neat type of speed-changing mechanism. In order to avoid destructive clashing when under load, and to guard against stopping the spindle when changing speeds, a suitable mechanism must be provided. The ease with which two spur gears may be engaged by sliding axially depends upon their relative rate of rotation, as well as upon the shape of the engaging ends of the teeth. In meshing sliding gears, the power should be disengaged from the driving gear just before engagement, allowing the driving gear to rotate by its own inertia until moved into engagement with the driven gear.

Disengagement of the sliding gears when working under load is also destructive; hence the power must be released from the driving gear as sliding commences, and withheld until the gears are out of mesh. With this cycle of operations, the only destructive forces acting upon the teeth are those of the momentum caused by the gear-driving transmission, and the axial force required to slide the gear. The constant speed employed in machine tool drives does not permit as favorable an application of sliding transmission as is found in automobile design, since in the automobile, the motor has a variable speed which may be throttled down until the speed of the driving gear is very nearly equal to that of the driven gear.

Ratchet and Pawl Mechanisms--Clutches

Certain leading manufacturers of turret lathes have experienced difficulty with the rachet and silent pawl mechanism. These mechanisms are generally used in transmitting low speeds and high pressures. As usually designed, the pawl is not made of large enough proportions to withstand the shocks to which it is subjected. Variations in workmanship also cause considerable trouble. These variations may occur in machining, heat-treating, assembling, or in two or three of these operations. The possible trouble these conditions may cause can be minimized by correct design with reference to these variations.

The friction clutch engages nicely and with the least amount of shock, but if the sliding gears are properly arranged, they have the advantage of greater simplicity. From the operator's point of view this means that no slippage will occur during a cut and consequently no adjustment need be made. Although occasional replacements are necessary, these occur at long intervals. From the standpoint of the turret lathe manufacturer, the simplicity of the sliding gear construction means a reduced machining cost, reduced cost for assembling and for conducting the "running-in" test which the machines receive prior to shipment, and reduced multiplicity of parts. Friction clutches involve more working surfaces, bearings, and mechanism than do sliding gears, and as a result increase the possibility of trouble. Frequently defects do not appear in the clutch until the running-in test is reached, so that delays and added expense often result.

Belt Speed

All turret lathe builders are agreed upon the advantage of the constant-speed pulley drive. Most of them, however, fail to recognize the economy of high belt speeds. Frederick W. Taylor, in his investigations on the subject, found that the most economical speed at which leather belts should operate is between 4000 and 4500 feet per minute. One of the leading turret lathes employs a speed as high as 2400 feet per minute, while several employ a speed as low as 1500 feet per minute. The only reasons the writer can suggest for the use of low belt speeds are: (1) Difficulty in assembling large pulleys on the countershaft; and (2) lack of suitable bearings for the driving pulley on the machine.

The first-named cause may be remedied without difficulty, and the second may be overcome by the judicious use of one or two ball bearings, the driving pulley bearings being about the most difficult to lubricate, as may be seen by referring to Fig. 2. This illustration shows at *A* a typical overhung construction of constant-speed driving pulley the tendency of which is to wear bearing *C* bell-mouthed. At *B* a similar pulley is shown, provided with a suitable ball bearing, which is an effective means of minimizing the trouble.

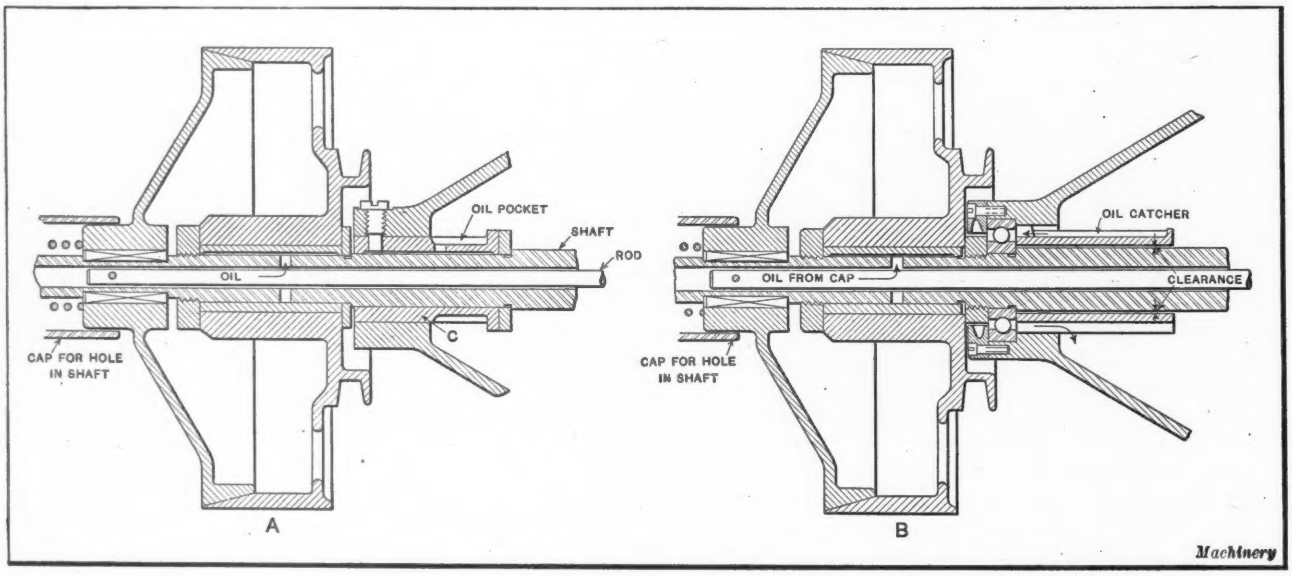


Fig. 2. (A) Typical Overhung Construction of Constant-speed Driving Pulley, showing Lubricating Arrangement. (B) Overhung Driving Pulley improved by Addition of a Ball Bearing

Means of Lubrication

Splash lubrication is most generally used in the head. A very good example of this lubrication system is that employed in the Herbert turret lathe, in which the oil is wiped from the face, near the periphery, of the large spindle gear and of the friction clutch, and thence guided by inclined channels to the front and rear boxes and to the driving

pulley bearings, thus insuring a copious supply of oil to these important parts. Reference to Fig. 3 will show the general arrangement of this lubrication system, from which it will be apparent that the spindle gear, when running at high speed, will throw the lubricant on the driving pinion and result in an oil spray for all the revolving members contained within the head. This English machine is also a notable example of accessibility of design, the head cover of which may be easily removed by reason of its being held in place simply by gravity and suitable ledges, so that it may be readily lifted from the head. The cover joints are oil-tight, although no fastenings are employed to make them so.

Bed Design

From actual tests it has been demonstrated that the box tubular form of bed is the best design for resisting the torsional and bending stresses to which it is subjected. The resistance of the bed to these stresses is usually determined by the thickness, depth, and continuity of the walls, as well as their distance from the neutral axis. With respect to wall continuity it is impractical to avoid providing holes for the removal of cores and for the passage of chips into the pan. Most makers observe the correct principle of bed construction except possibly in regard to the location of supports, which should be placed as nearly under the fixed and moving loads as is possible. By this means the tendency of the bed to twist and spring when resting on an uneven surface is avoided. The correct and incorrect location of supports with respect to loads is shown at *A* and *B*, respectively, in Fig. 4.

In American lathe design, vees continue to be the popular guiding surfaces for the saddle and the slide, one good design in this respect being made with the front vee wider than the rear, thus taking care of the greater amount of wear to which the front vee is subjected. The rack seems to have no better situation than immediately under the front vee.

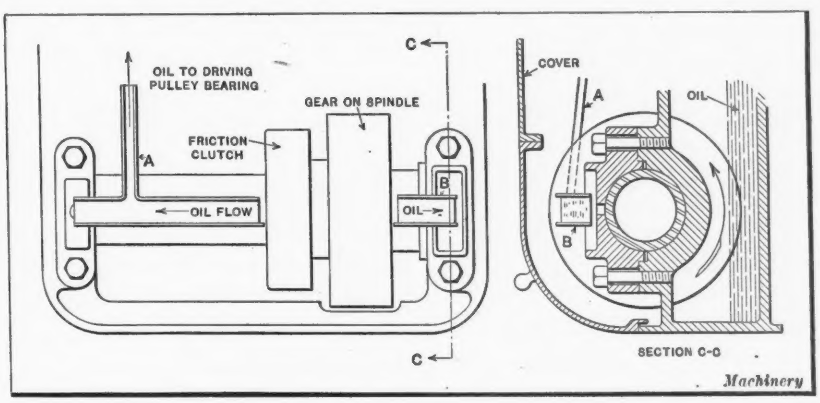


Fig. 3. Lubricating System employed in an English Turret Lathe

The Chip Pan

The requirements of the chip pan are that it shall contain the average day's run of chips and provide a water-tight tray in which to catch the cutting compound and return it to the pump; that it shall not prevent the operator from standing close to the work; and that the chips may be removed from the pan without difficulty. These conditions are followed closely in practice except for the provision for removing chips. This operation usually takes considerable digging and scraping, which can be avoided if free access both to the front and rear of the pan is provided for, so that a truck can be run beside the pan and the entire contents easily transferred to it. Sheet steel is probably the most used metal for chip pans, its chief advantage being that it is cheaper than a cast pan.

Apron Mechanism

The functions of the apron are as follows: (1) To contain reducing gears; (2) to impart to the saddle its longitudinal motion; (3) to contain the various feed control mechanisms. The cutting tool operates at a considerable distance from the point at which the power is applied to the machine. The best means for transmitting this power is by a comparatively small diameter shaft. The tool must also be fed into the work at a reduced rate of speed from that of the driving gears; to transmit this power it follows that in order to maintain maximum rigidity at the tool point, the correct place to make the reduction with the least amount of strain is as close to the point of application as is practicable. For this reason the apron and its gearing are provided.

Strength Required in Apron Mechanism

Past and present performances of many makes of machines would indicate that this part of the machine should receive greater attention by designers. Indications partially substantiate the statement of Mr. Taylor who maintained that this entire mechanism should be made strong enough to allow the feeding pressure to be as great as the driving pressure upon the lip of the tool. The best place for the location of the feed control on a turret lathe is on the apron, and this feature has been well taken care of in most turret lathes. The most practical control should be designed to operate with one hand, but not much has been done to develop such an improvement. This might also be said of the feed-reversing mechanism, of which it might further be noted that while the right- and left-hand worm-wheel is a very ingenious mechanism, it does not wear well, and hence, in some cases, does not reverse readily. The reduced wearing surface is shown in Fig. 5, in which at *A* is shown a section of a worm-wheel tooth, hobbed right- and left-hand, and at *B* a tooth section hobbed right-hand only, both sections being taken on the pitch line. One well-known engine lathe maker casts the apron integral with the saddle—a construction which seems commendable to the writer.

The Saddle

The functions of the saddle are to provide a base of maximum stability for the turret; to provide long guiding surfaces and to house certain mechanisms. It should be sufficiently heavy to absorb shocks. The vee bearings for the saddle are subject to much abrasion by the action of small particles of chips, sand, scale, etc., the tendency for this foreign matter being to work into these bearings. This is the case in all slides which are in any degree exposed. Assuming that the guide over which the slide first passes is covered with dirty oil or dust, the action of this dirt will be to travel clear along the surface in contact. One good way to overcome trouble from this source would be to force out the unclean matter with clean oil. If, in such a scheme, felt wipers could be employed, the arrangement would not be open to the objection of requiring specially shaped pieces of material for this purpose.

Lubrication is often, by necessity, the last condition to be worked out in many designs, and unfortunately, by pressure of circumstances, is given the least consideration. The principle of self-lubrication should be developed and applied to every unit in so far as possible, so that all moving parts can be automatically lubricated.

Types of Turrets

There are two types of turrets used on the lathes under discussion—the flat turret and the hollow hexagon turret. The advantages claimed for the flat turret are: (1) Suitability for holding any type of turning or single-point boring tool in any position relative to the work; (2) provision for maximum area of support upon which these tools can be mounted and rotated; (3) provision for the largest diameter in which to locate a locking pin and upon which gibs may bear; (4) possibility of boring or turning all diameters within the full capacity of the machine (in conjunction with a cross-slide)

without the use of special equipment for each size; (5) and the possibility of using hexagon turret tools.

The principal advantage of the hexagon turret is its rigid support with respect to thrust and torsion. From this it would follow that heavy forming cuts could best be made with this type of turret. Comparison between the set-ups on the hexagon and those on the flat turret show that the holders for the single-point turning and forming cutters used on the hexagon turret are very much overhung. This may be overcome to some extent, at an increase in cost of tools, by piloted supports, or by the use of an auxiliary carriage. The auxiliary carriage is a feature which will doubtless pay for itself many times over as a time-saver.

Types of Tool Stops

There are two principles which may be employed to arrest the motion of the tool: (1) arresting the force which produces the motion; and (2) diverting the force. Under the first of these may be classified the observation stop and the positive stop or abutment; under the second may be mentioned the cam and the knock-off or tripping mechanism.

The problem of constructing an accurate stopping mechanism presents certain difficulties which have not yet been fully solved. Multiple tooling requires a stop for each tool or group of tools. The ideal place for the feeding pressure to be applied to the tool is almost in line with the tool lip. The stop should be in this line also, which condition is usually impracticable. The tool in turning accurate shoulder lengths should remain stationary until it has, at the end of the cut, faced the shoulder square. Deflection of the cutting edge of the tool radially with reference to the work results in a double error in the diameter of the work produced. For this reason the turning of accurate diameters is more difficult to accomplish with the use of a stop than the turning of accurate shoulder lengths.

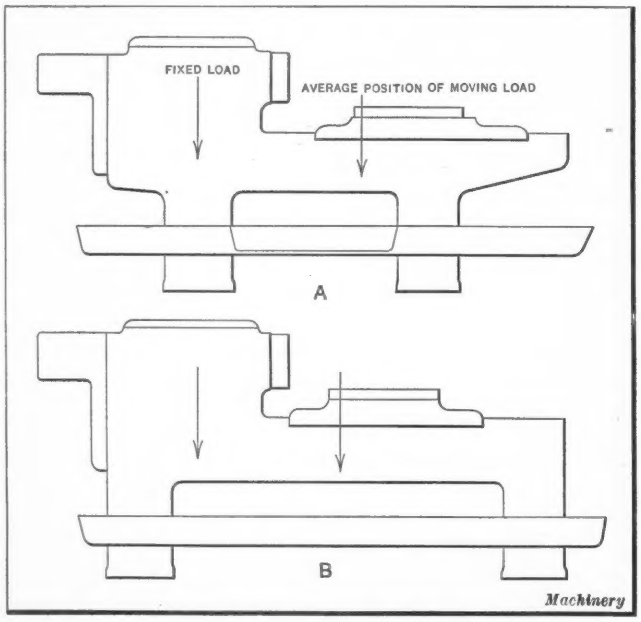


Fig. 4. (A) Lathe Bed Support correctly placed. (B) Support incorrectly located in respect to Load

The observation stop, as usually constructed, consists of a fine-pitch screw, nut, thrust bearing, a large-diameter and finely graduated dial, and a pointer, together with the usual slides, the gibs on which are set up so as to avoid any vibration or looseness. The effectiveness of this mechanism depends upon the operator's eye and sense of touch. The most important parts of the mechanism from the designer's point of view are those relative to the dial and the lead of the screw. In this and all other types of stops, it is probable that the oil films play an important part in the accuracy obtained in the work.

The positive stop consists of an abutment so located that pressure may be brought to bear against it, thus putting an initial stress upon the mechanism. This form of stop is generally the easiest to use, since it relieves the operator of eye strain; also the variations resulting in the work from the employment of this form of stop are, as a rule, within the tolerances allowed in the shoulder lengths on the work.

The stop obtained by the action of cam feed is very effective. The force in most cam mechanisms is, when feeding, increased from a minimum to a maximum, and decreased to zero at the termination of a cut. A great deal can be said about the employment of cam feed mechanisms on turret lathes, but this subject is not within the scope of the present article.

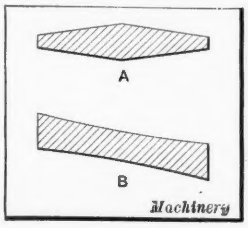


Fig. 5. Sections at Pitch Line of Feed-reversing Mechanism Worm-wheel

The self-acting trip mechanism is open to objection on account of the sudden release of feeding stresses caused by the quick disengagement of the feed. This objection is usually overcome in a measure by the use of an auxiliary positive stop, against which the operator must hold the tool.

In conclusion the writer wishes to call attention to Mr. Taylor's discovery in 1883 that a 40 per cent increase in turning speed is possible in machining steel, by the use of a copious supply of water to dissipate the heat generated at the tool lip. This should be considered especially in multiple tooling arrangements.

* * *

HOW MANY OF THESE ACCIDENTS ARE PREVENTABLE?

Recent figures published by the Bureau of Labor Statistics, Washington, D. C., show that there are 38,000,000 wage earners in the United States and that of these, 700,000 annually meet with accidents serious enough so that they are incapacitated for work for an average of four weeks each. This is equivalent to a loss of at least $50,000,000 in wages. There is no record showing how big a sum was paid in compensations, but doubtless it ran into many millions. If on the one hand workers were more careful, and if on the other, part of the money spent in compensation had previously been spent in providing safe working conditions, safeguards, and education for the workers in regard to dangerous practices, it is likely that the number of accidents could have been very materially reduced.

Statistics covering industrial accidents also show that the largest number of accidents per hour occur between 11 and 12 o'clock in the forenoon, and between 4 and 5 o'clock in the afternoon. The fewest number of accidents occur between 7 and 8 o'clock in the morning, and between 1 and 2 o'clock in the afternoon. There is a steady increase in the number of accidents per hour from the beginning of work in the morning until noon, and from 1 o'clock until the closing hour. Obviously, men are more alert when they begin work, and become either fatigued or careless as the hours pass on.

* * *

SOUTH AMERICAN TRADE OPPORTUNITIES

There appears to be great activity in the railway and industrial fields in most of the South American countries. The Argentine Republic is expected to expend $40,000,000 for rolling stock and railway electrification. A considerable amount of machinery for industries of all kinds will also be imported during the next year, particularly electrical machinery and machinery used in the flour milling industry and agricultural work. Chili affords a good market for structural steel and hardware, agricultural machinery, and tractors. In Ecuador nine textile mills are planned, and in Venezuela sugar machinery is being bought. In connection with the railway shops, mining industries, and textile mills, there will, of course, also be repair shops that will require a certain number of machine tools.

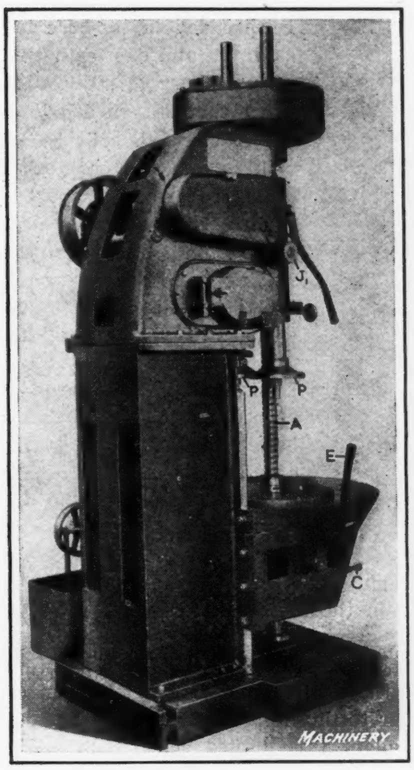


Fig. 1

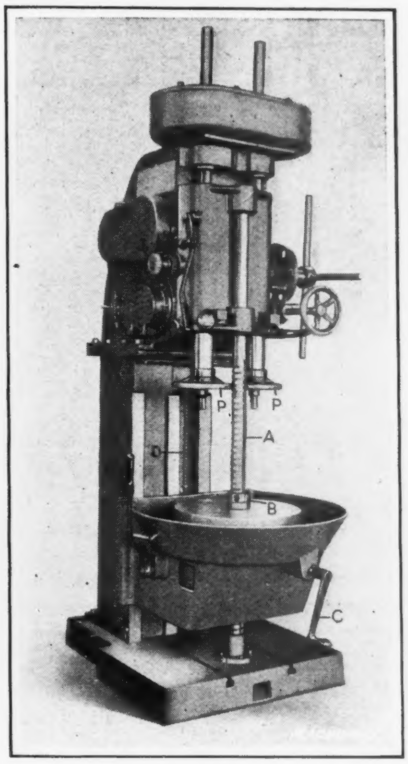


Fig. 2

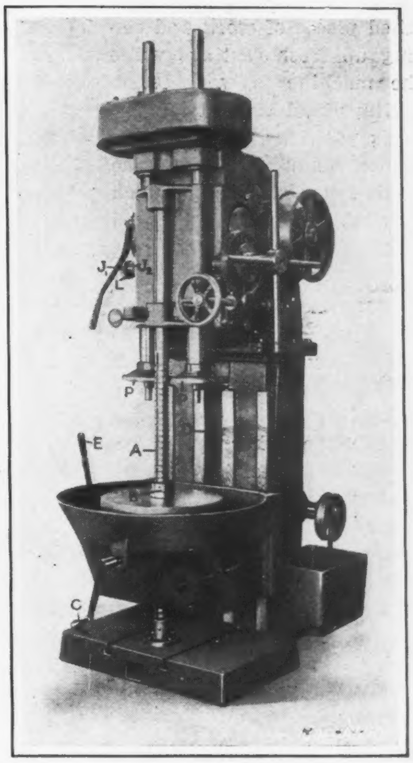


Fig. 3

Continuous Production Drilling

Methods Whereby High Production is Obtained in Drilling—Based upon the Practice of Baker Bros., Toledo, Ohio

TO attain maximum efficiency in the performance of any machining operation, there are two general factors to take into consideration. Means must be provided for actually cutting the metal at a satisfactory rate, and care must also be taken to see that the idle time of both the machine and its operator are reduced as far as possible. It will often happen, especially in cases where the time required for taking the cut is relatively short, that the nonproductive period during which the operator is loading and unloading the jig or fixture is considerably greater than the time during which the machine is engaged in the performance of work. Bearing this fact in mind, designers of several different types of machine tools have endeavored to make provision for keeping both the machine and the operator constantly employed.

A case in point is shown in the accompanying illustrations which show a production drilling machine which has recently been added to the line of Baker Bros., Toledo, Ohio. This is a two-spindle machine and it is equipped with an indexing table that provides for carrying successive pieces of work under the spindles. There are three stations on this table, and the usual practice is to have fixtures of the same design mounted in each position. Possibly the arrangement will be best understood by referring to Fig. 4, which shows a plan view in diagrammatic form. Here it will be seen that the so-called chucking position is at the front and that the table is indexed through 120 degrees at each movement.

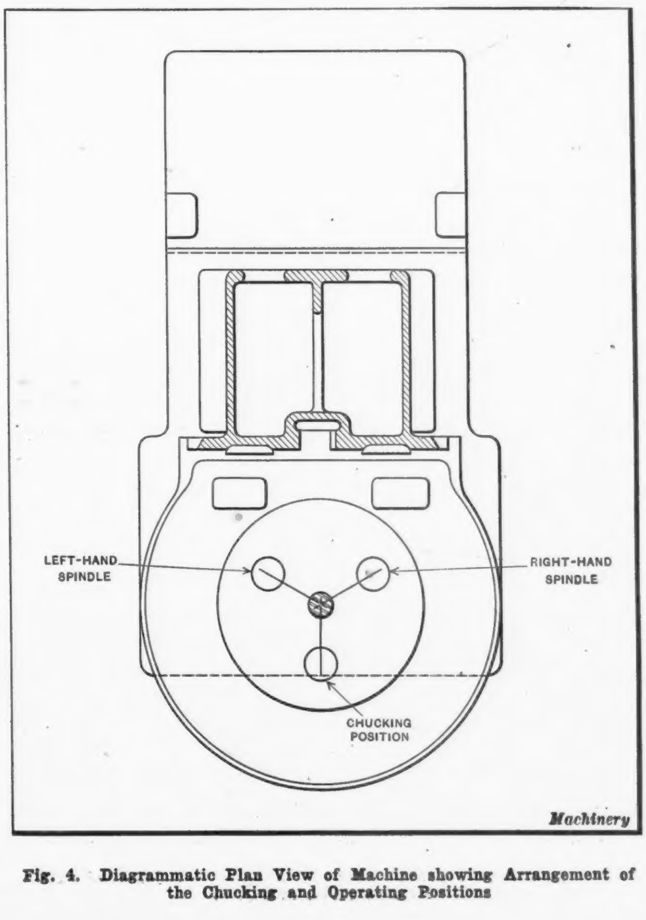


Fig. 4. Diagrammatic Plan View of Machine showing Arrangement of the Chucking and Operating Positions

After a piece of work is set up in the chuck, it is indexed to a position under the left-hand spindle, which is furnished with a tool to provide for performing the first operation. At the next indexing movement, this piece of work will be advanced to a position under the right-hand spindle, where another operation will be performed. With a machine of this type, drilling and reaming or similar sequences of operations can be performed successively, and in cases where a number of holes are required in the work, multiple-spindle auxiliary heads can be utilized to afford increased efficiency. The advantage of a machine of this type over one which is not furnished with the indexing table is that the operator can be kept constantly employed in removing fin-

ished pieces of work and setting up fresh castings while the machine is working on castings held in the two operating positions. As a result, the only non-productive time is that period during which the table is being indexed from one position to another.

Improved Features Incorporated in the Design of this Machine

Most readers of MACHINERY are familiar with the No. 217 heavy-duty drilling machine built by the Baker Bros.; the general outline of the present machine is quite similar. Consequently, the present article will concern itself only with those features which have been added to provide for practically continuous operation. A description of the tools and methods used in handling several typical jobs on this machine will also be presented.

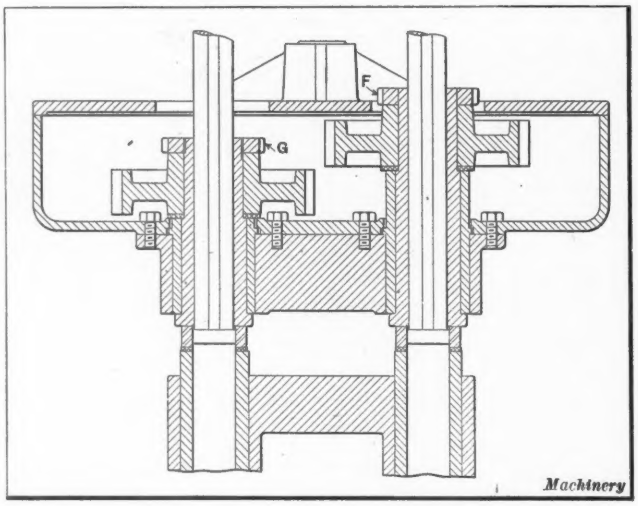


Fig. 5. Arrangement of Independent Spindle Drives which enable Suitable Speeds to be employed for Successive Operations

Arrangement of the Indexing Table

As the provision of an indexing table to obtain continuous production is the outstanding feature of this new drilling machine, it is natural to start the description at this point. The reader is cautioned not to infer from the illustrations that feeding of the work to the tools is accomplished by elevating the table. Such a conclusion would be more or less natural in view of the large screw *A* which will be seen in Figs. 1 to 3, passing through the center of the table. This is for the purpose of bringing the table exactly perpendicular to the spindles and also to afford a convenient means of setting the table in the desired vertical position. When the proper setting has been obtained, the two lock-nuts *B* above the table are tightened down and then crank-handle *C* is turned, which results in raising a binding collar into contact with the under side of the table, thus forcing the finished upper face of the table into contact with the finished under side of the lock-nut and accurately aligning the table with the spindles. The binding collar is threaded in its bore to fit screw *A*, and has teeth cut in its periphery to mesh with a worm that is turned by crank *C*. A chain *D* will be seen rising from the back of the table to make connection with a counterweight inside the column, that facilitates raising and lowering the table; and the lever *E* which withdraws the index-pin is located at the left-hand side. In indexing, the method of procedure is to loosen the binding collar by turning crank *C*, then withdraw the index-pin and push the table around until it has passed through 120 degrees, at which time the index-pin snaps into the hardened bushing that locates the table in the next position.

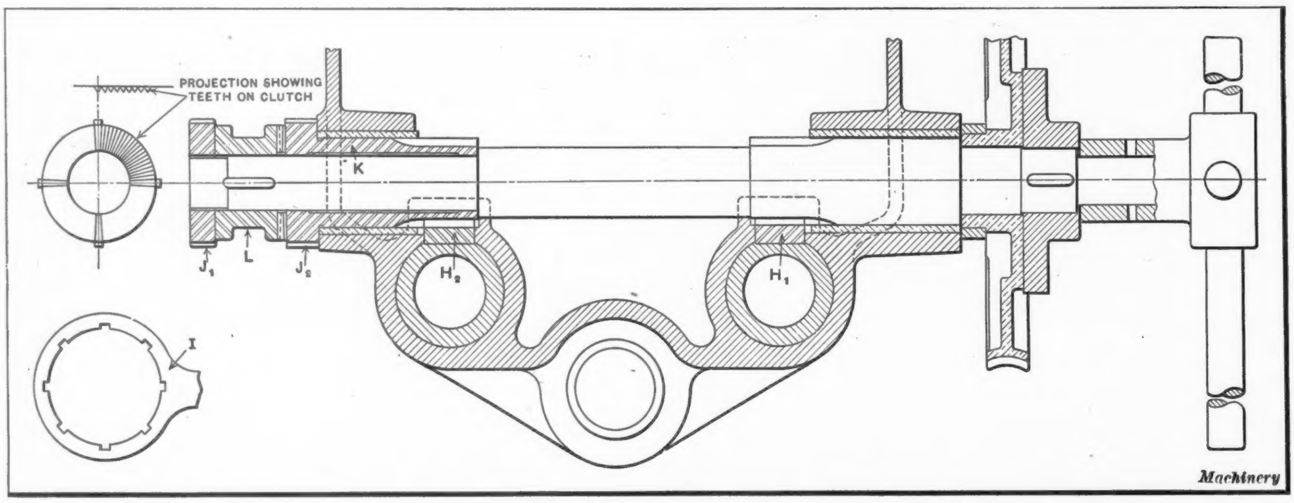


Fig. 6. Sectional View illustrating Arrangement of Means for obtaining Independent Vertical Adjustment of the Two Spindles

Spindle Construction and Auxiliary Mechanism

General features of the driving and feed mechanisms for the spindles are similar to those on the No. 217 Baker drilling machine, but to adapt this duplex continuous drilling machine for the peculiar requirements of its work a number of modifications were found necessary. It has already been explained that on machines of this type it is the usual practice to perform successive operations under the two spindles; and it may happen that there is a very considerable difference in size between the drills carried by the left-hand and by the right-hand spindles. Such being the case, it will become apparent at once that in order for both tools to work efficiently there must be a considerable difference in the speeds of rotation at which the spindles are driven.

At this point attention should be called to the fact that these are essentially production machines which are built especially to meet the requirements of a single class of work, and the spindle driving gears are designed to give the proper speeds of rotation for this particular job. The arrangement is quite clearly shown by Fig. 5 where it will be seen that there are individual

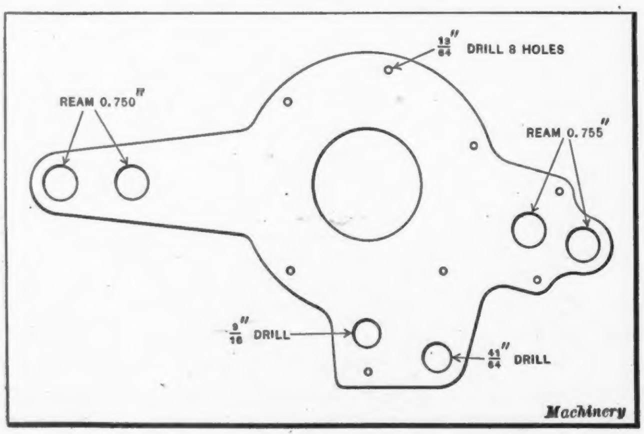


Fig. 7. Motor Car Brake Spider which is drilled and reamed on the Machine shown in Fig. 10

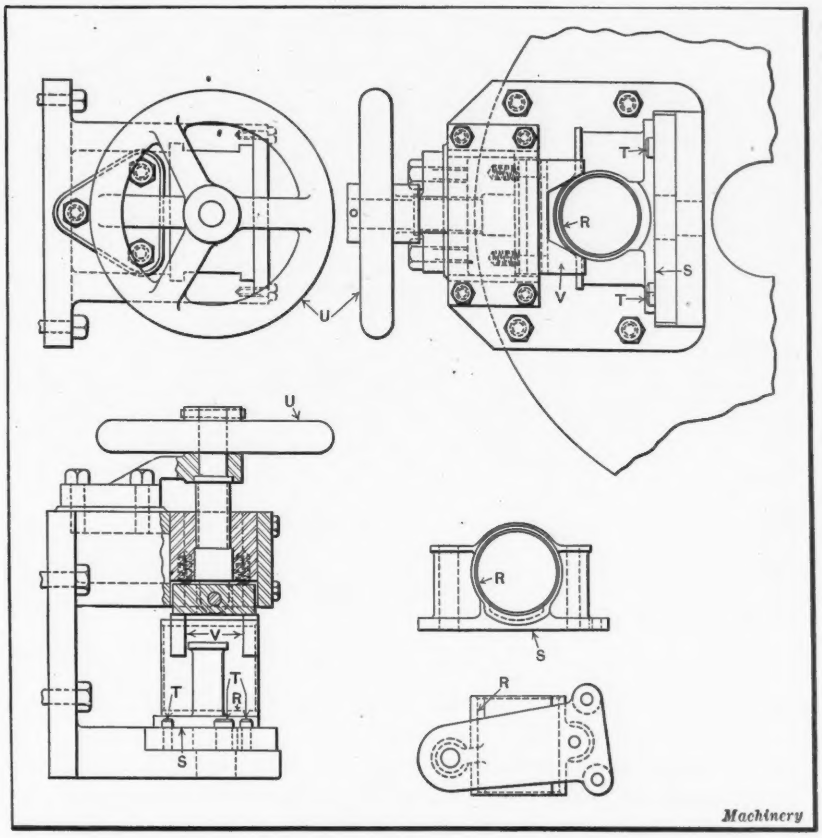


Fig. 8. Motor Car Spring Seat to be bored and reamed at R, and Work-holding Fixture for performing this Operation

spur gears which are splined to the spindles and held in the desired positions by means of threaded collars F and G that clamp the gears up against shoulders provided on the spindle quills for that purpose. It should be explained that the pinions which mesh with the spindle driving gears are located at the back, so that they do not show in this illustration.

The feed-works are the same as on previous Baker drilling machines, power feed being provided by gears contained in a case at the left-hand side, while hand feed and rapid traverse of the spindles are accomplished by the small handwheel and capstan wheel at the right-hand side. The available range of feeds is from 0.003 to 0.145 inch per revolution, and spindle speeds are available from 47 to 585 revolutions per minute. With a duplex machine of this type, it is necessary to supplement the feed movements with provision for independently regulating the vertical positions of the two spindles relative to each other. This result is accomplished by the mechanism shown in Fig. 6. Here it will be seen that steel racks H_1 and H_2 are inset into the spindles, and these racks mesh with pinions that may be turned independently of each other to provide individual adjustments for the spindles.

The way in which this result is accomplished is as follows: A wrench I may be engaged with either of the nuts J_1 or J_2. Nut J_1 is keyed directly to the end of the cross-shaft, and when this nut is turned it rotates the pinion that meshes with rack H_1, thus raising or lowering the spindle by which this rack is carried, according to the direction of rotation. Similarly, nut J_2 is formed at the left-hand end of sleeve K which has cut in its right-hand end the teeth of the pinion that meshes with rack H_2. Sleeve K turns freely on the cross-shaft, thus allowing rack H_2 and the spindle by which it is carried to be raised or lowered through turning nut J_2. It will be evident that wrench I is designed so that it may be slipped right over nut J_1 to bring it into engagement with nut J_2. By engaging clutch L connection is made between the cross-shaft and sleeve K, so that by turning either nut J_1 or J_2 with wrench I, the two spindles may be raised or lowered in unison.

Drilling and Reaming Motor Car Brake Spiders

Fig. 7 illustrates a malleable iron motor car brake spider in which there are fourteen holes to be drilled. After they have been drilled, four of these holes have to be reamed. This job is handled on one of the Baker continuous drilling machines, the method of procedure being to drill thirteen holes at the first station with a multiple-spindle auxiliary head; and the table is then indexed to the next station, to ream four holes and drill one with a multiple head carried by the second spindle. These pieces are made in pairs consisting of one right-hand and one left-hand spider, and to facilitate production it is the practice to make the drilling jigs, as shown in Fig. 10, with provision for placing a right-hand spider on the top of plate M and a left-hand spider below this plate. Then it is possible to have the same drills and reamers pass through the first piece of work and through guide bushings carried by plate M, to drill or ream the corresponding holes in the second piece of work that is bolted against the under side of the jig.

It would be difficult to maintain the required degree of accuracy if an attempt were made to drill the holes through both pieces of work, guiding the tools from bushings carried in the jig plate N located above the upper casting O. Before finishing a hole in the lower piece, a drill so guided would be likely to show a tendency to run out of line. It is to avoid trouble of this kind, that the upper jig plate N is made to come down on top of the work, and the plate M between the two castings is equipped with a duplicate set of jig bushings to guide the drills through the second casting. Only one casting O is shown in place in this fixture. The holes drilled by the first multiple head are as follows: Two 0.755-inch holes; two 0.750-inch holes; one 41/64-inch hole; one 9/16-inch hole; seven 13/64-inch holes. The work performed by the second head is as follows: Ream two 0.755-inch holes; ream two 0.750-inch holes; drill one 13/64-inch hole.

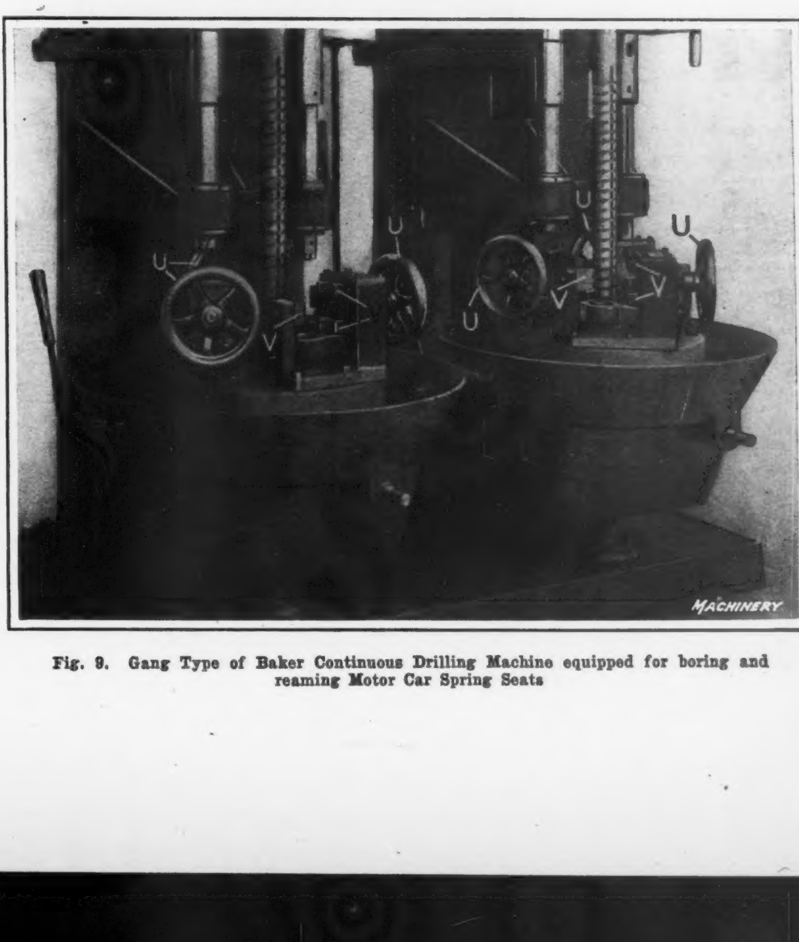


Fig. 9. Gang Type of Baker Continuous Drilling Machine equipped for boring and reaming Motor Car Spring Seats

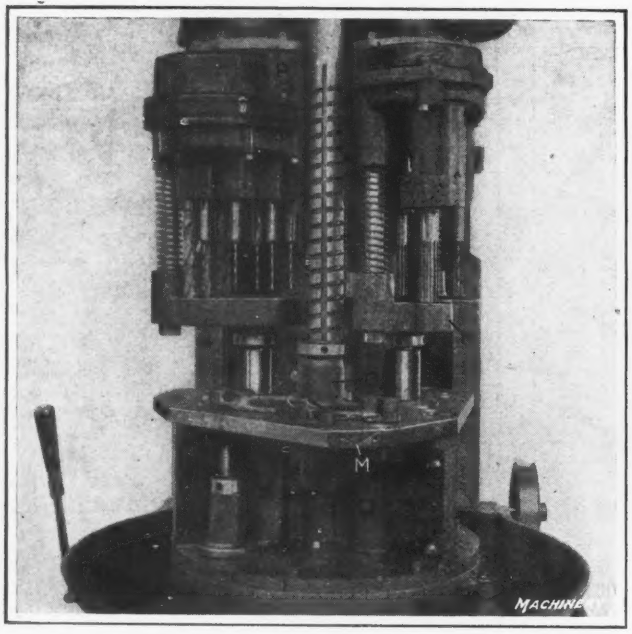


Fig. 10. Close-up View of Tools used for drilling and reaming Motor Car Brake Spiders

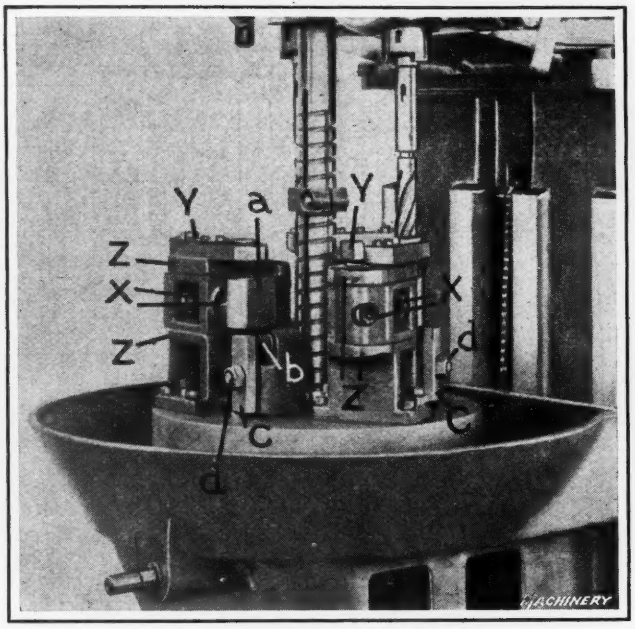


Fig. 11. Baker Continuous Drilling Machine equipped for counterboring and reaming Motor Car Steering Knuckles

Figs. 1 to 3 and Fig. 10 clearly illustrate a feature of this Baker Bros. drilling machine, namely, the provision of a flanged end *P* on each spindle to provide a convenient means of securing an auxiliary multiple-spindle drill head in place. Projecting beneath the flange there is an extension of the spindle which enters the main driving gear of the auxiliary head, thus enabling the head to be secured to the spindle in a manner that makes it as nearly as possible an integral part of the drilling machine. There is an independent clamping bolt *Q* to secure the piece of work in place on the under side of the jig plate *M;* and preparatory to drilling, the castings are disk-ground on their under side. Location is accomplished by swinging the casting about the center pivot, over which it is placed on the fixture, until it comes into engagement with a pin provided for that purpose.

In the lower right-hand corner of Fig. 8 there is illustrated a motor car spring seat made of malleable iron, in which it is required to drill and ream hole *R;* and the remainder of this illustration shows three views of the fixture used for handling the job. The best illustration of the way that the casting is held for boring and reaming is shown in the upper right-hand view, where it will be seen that the flat face *S*, which has previously been disk-ground, is placed against the fixture in which there are two pins *T* that enter holes in the casting to provide for its accurate location. After this preliminary setting has been secured, the piece is clamped in place by turning handwheel *U* that forces a V-block *V* into contact with the cylindrical portion of the casting at its upper and lower ends, thus holding the work firmly in place. By referring to Fig. 9, the reader will obtain a better idea of the way in which these fixtures are constructed. As in the previous case, there are three fixtures distributed around each drilling machine table, so that the operator can busy himself in loading and unloading the fixture in the idle position while the boring and reaming operations are progressing at the other two stations.

Boring and Reaming Motor Car Steering Knuckles

In Figs. 11 and 12 there are shown one of the new Baker Bros. drilling machines equipped for the performance of counterboring and reaming operations in forged motor car steering knuckles, and the jig used for holding the work while these operations are performed. As they come to the machine, these pieces have had the tapered shank *W* turned and the hole drilled in the lower boss on the forging, which is in a plane at right angles to the boss containing the hole to be counterbored and reamed on the present machine. Referring first to Fig. 12, it will be seen that the tapered shank *W* of the work is pushed into two hardened bushings *X*, the inside diameters of which are of the proper sizes to grip the large and small ends of the shank. These bushings are carried by a block that is mounted on a pivot *Y* so that the block is free to swing outward from its normal position between the upper and lower members of the jig body.

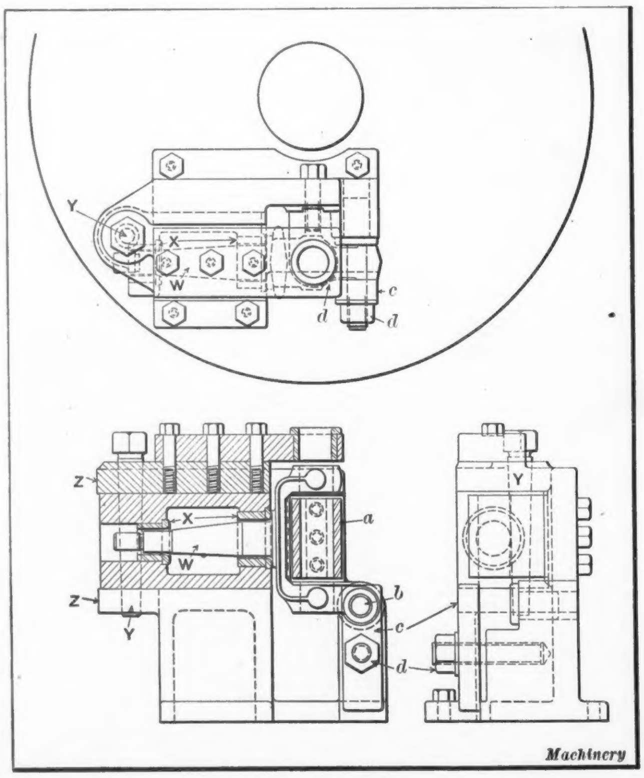
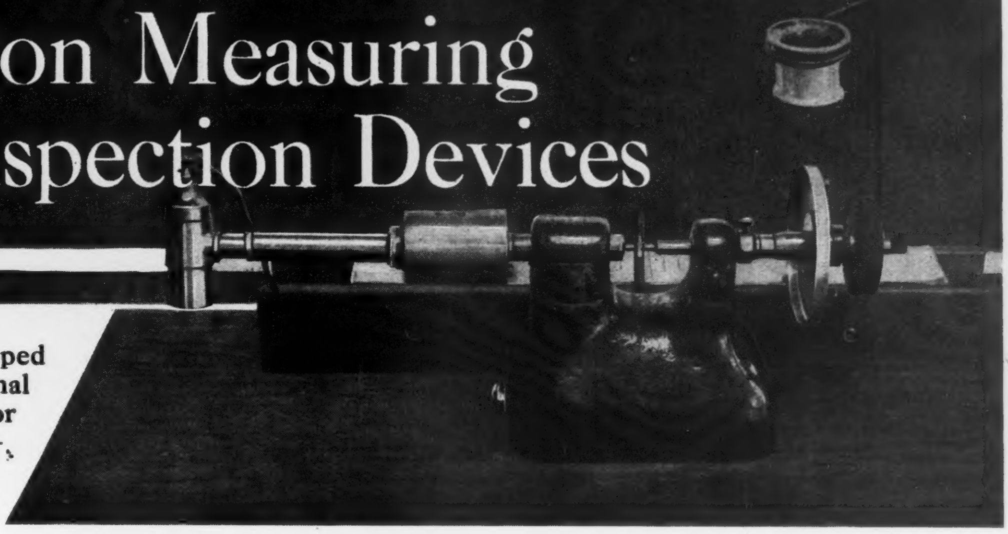


Fig. 12. Work-holding Fixture used on Machine shown in Fig. 11 for counterboring and reaming Motor Car Steering Knuckles

The counterbore and reamer used for the performance of the required operations on this piece are both piloted to maintain the desired alignment, and these pilots run in a hardened bushing *a*. It is necessary to have the block that carries bushings *X* swing outward, as previously described, in order to clear bushing *a* and allow the taper shank *W* to enter bushing *X*. The forging clears bushing *a* as it is swung into the drilling position; and the drilled hole in the lower arm of the forging pilots on a pin *b*. Clamping is accomplished by a strap *c* and bolt *d*.

Precision Measuring and Inspection Devices



Optical Methods Developed at the British National Physical Laboratory, for Facilitating Inspection—First of Two Articles

By R. J. WHIBLEY

A MEASURING machine of the Newall type uses a spring-controlled, movable anvil provided with means for indicating a definite amount of pressure. This provision is of great importance since it makes the machine practically independent of the operator. The Newall measuring machine indicates this pressure by magnifying the movement of the anvil by an amplifier that carries a specially constructed fluid level. With this device the micrometer head can be brought, in a single movement, to the measuring position and the location of the bubble in the level can be constantly seen, thus indicating the extent and direction of the required movement. But difficulty arises when rapid work is attempted with this machine, because the viscosity of the liquid in the level tube causes a lag in the movement of the bubble. This condition was very noticeable when many small wires, such as used in screw thread inspection, were measured at the National Physical Laboratory. If the wires were placed in the machine and rotated, the bubble in the level was slow to show variations in diameter of 0.00005 inch.

The arrangement now used at the laboratory is shown in Fig. 1. *A* is the ordinary level tube of a Newall measuring machine, and *B* is a clip carrying a mirror *C* on which is mounted a small plano-convex lens. A Nernst lamp illuminates a thin cross-wire against the plano-convex or half lens. This lens, since it is mounted on a mirror surface, functions as a complete double convex lens and brings the image of the cross-wire to a focus on the scale *E* after reflection from a mirror above. The mirror carrying the lens must be held in its frame as lightly as possible, as any distinct gripping deforms the lens system sufficiently to prevent an image being formed. On the scale, 0.35 inch represents a movement of the anvil of 0.0001 inch, so that the total magnification of the machine with this arrangement is 3500. The device shows by a dead beat indication a variation from roundness of 0.00001 inch in the small gage wires previously mentioned.

It is worth while noting here that in general the measuring machines used at the laboratory are not used for absolute measurements, but for comparisons. A gage, whose dimensions are known to a high degree of accuracy, is set up in the machine and the cross-wire image brought to zero. Other gages, which are the same nominal size as that of the standard used, are inserted and the image of the cross-wire brought to zero on the scale. The same range of measuring screw is in use, and all other conditions being identical at each measurements, truly comparative readings are obtained.

Another attachment that has proved extremely useful on a smaller measuring machine of the bench micrometer type is shown in Fig. 2. The interesting part of the attachment is the optical amplifier, two small mirrors being used facing one another. One of the mirrors *A* is fixed, and the other *B* is secured to a thin steel strip *C* two or three thousandths of an inch in thickness, which is deflected by the travel of the moving anvil *D*. A beam of light strikes the moving mirror, is reflected on to the fixed mirror, to be again reflected to the moving mirror which ultimately reflects the beam to a vertical scale. The emerging beam of light has been deflected through an angle four times that of the mirror movement, and this, together with the bending of the steel strip, gives an image movement on the vertical scale of 0.1 inch for a travel of 0.0001 inch of the anvil.

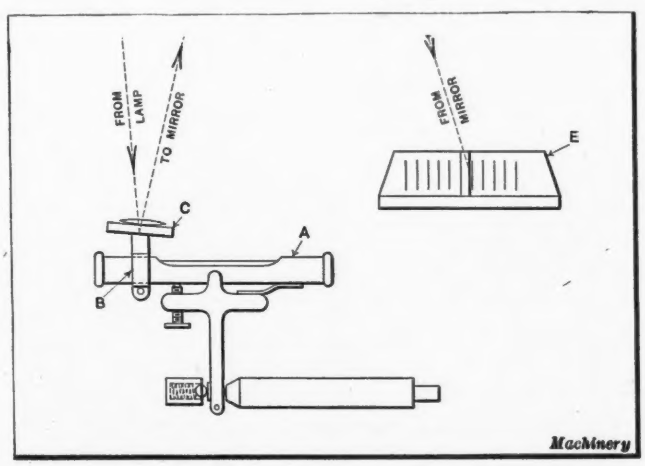


Fig. 1. Optical Attachment for Standard Type Measuring Machine

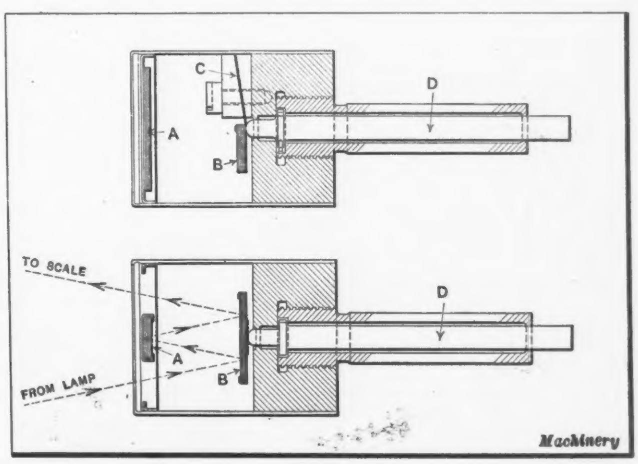


Fig. 2. Optical System used on Machine of the Bench Micrometer Type

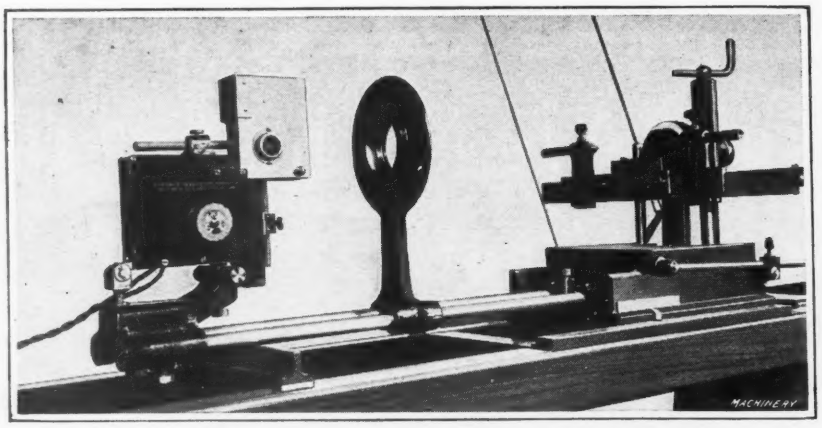


Fig. 3. Horizontal Projector for examining the Form of Screw Threads

In one application of this arrangement the light is not passed directly from the mirror system to a scale, but passes vertically downward through a slot in the bench and thence to a mirror at the floor level, which reflects the image of a pea lamp filament on a horizontal translucent scale located immediately behind the machine. This arrangement gives a still greater magnification, and the position of the scale renders observation less tiring. In the machines described the scale can be moved to bring the zero reading in coincidence with the cross-wire or filament image when a standard gage is inserted.

Projection Apparatus

A most striking innovation in the methods employed at the National Physical Laboratory consists of projecting a form silhouette on a screen of any gage that requires inspection. In this way a considerably magnified image is obtained on a plane surface so that it is easy to compare it with a line drawing of the correct form which is enlarged to the same degree. The simplicity of the projection apparatus arrangement is notable and has proved invaluable in the examination of screw-thread forms. Very definite data exist for the flank angles and shape of the top and bottom of screw threads in many standards, and it was usually considered that carefully made screw gages or screws were fairly accurate in this respect. The projector has shown that this was not the case, screw gages believed to be accurate by the makers showing extraordinary irregularities of form when magnified 50 diameters on the projection apparatus. It is now realized that screw gages may pass gages for root, pitch, and outside diameters, but still be far from accurate in form, and this fact has no doubt accounted in the past for many inexplicable breakdowns. The same difficulty occurs with formed tools of all kinds. To make the dimensions and form clear, the draftsman usually makes an enlarged view. A toolmaker, therefore, cannot be expected to make the actual size piece accurately in all respects without some means of magnifying his work. The great advantage of the projection method is that it not only shows when the form is correct or incorrect, but in the latter case shows the exact direction and magnitude of the inaccuracy. In the case of press tool work, blanking tool tables may give the proper clearances to allow for different materials and thicknesses, but there is no doubt, in the case of an intricate form of punch and die, that regularity of clearance throughout the perimeter of the punch and die cannot be obtained by ordinary inspection methods. With a projector, sections of the perimeter of the punch and die can be examined during the making, and perfect fitting obtained in a much shorter time than is possible when working practically in the dark. The projection instrument has been developed in two forms, one projecting the image horizontally on a vertical screen, and the other projecting vertically on a horizontal mirror, which reflects the image downward on a table immediately under the eyes of the machine operator.

The Horizontal Projector

The horizontal projector is shown in Fig. 3. These instruments are made to National Physical Laboratory design by George Cussons, Ltd., Broughton, Manchester, England, and consist of a special arc lamp seen at the left of the bed, a condenser, and the carriage at the forward end of the bed which carries on a support the compound projection lens. Also mounted on the forward carriage is a table which supports the work to be examined either between the adjustable centers, which can be seen, or on a small table clamped in any desired position. The work-table can be moved to and fro along the carriage for a short distance for the purpose of putting the object into or out of focus on the screen. The arm which conveys this movement carries a small block which allows the mean position of the work being examined to be varied. A small eccentric passes through the block and is mounted on a transverse shaft which is rocked by cords operated by the inspector at the screen.

The question of projection lenses is one that has caused considerable difficulty. The practice is to use a high-grade wide-aperture photographic lens and mount it with a field lens. By careful pairing it has been found possible to practically eliminate distortion of the projected image. The screen is seen in Fig. 4 with the projected image of a profile. The screen board can be moved horizontally or vertically by the operator for the purpose of superimposing the pattern drawing of the profile exactly in position over the image of the piece under examination. The magnification used is 50 diameters, and it is quite easy to see and estimate the extent of even slight divergences from the pattern.

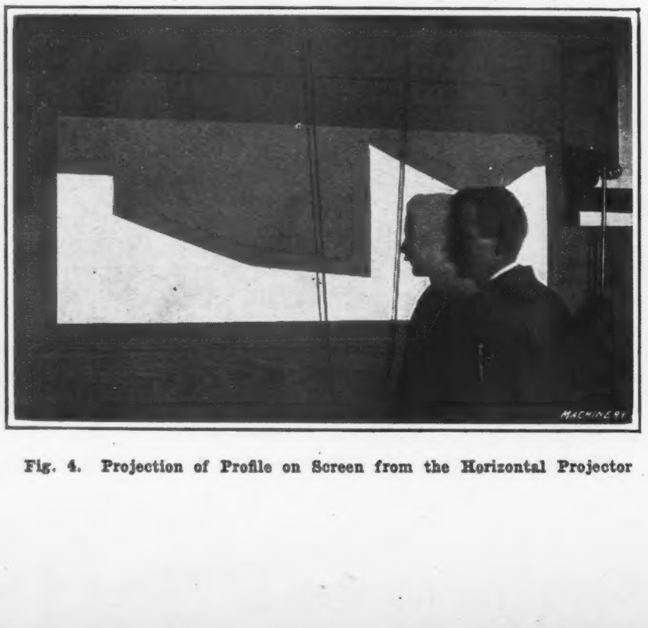


Fig. 4. Projection of Profile on Screen from the Horizontal Projector

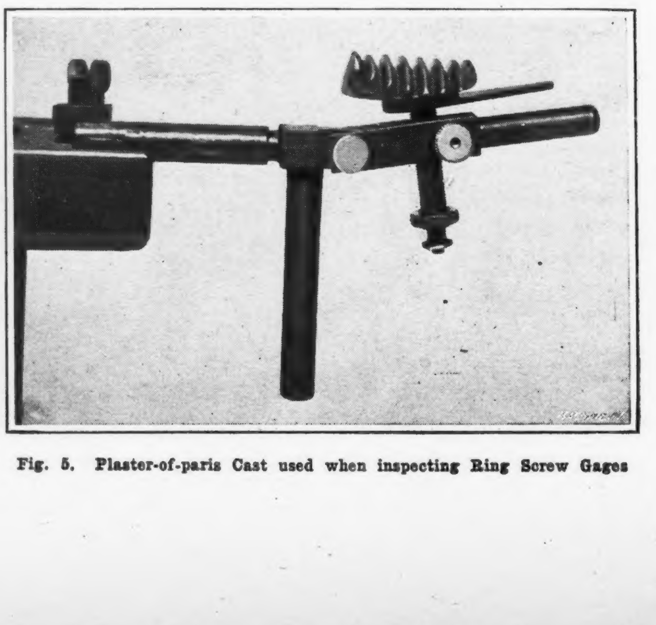


Fig. 5. Plaster-of-paris Cast used when inspecting Ring Screw Gages

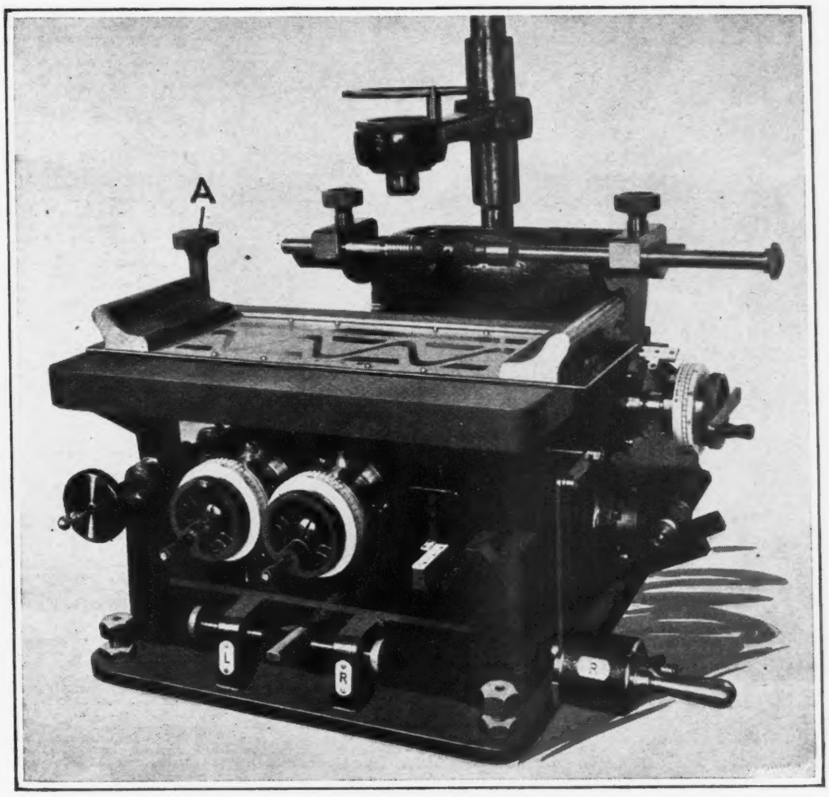


Fig. 6. Vertical Projector for examining the Form of Screw Threads

When examining the screw thread form it is important that the parallel rays from the condenser pass over the threads at an angle from the vertical axial plane and perpendicular to the helix angle of the thread. To secure this result, the rails carrying the arc lamp and the condenser can be swung around independently of the front carriage. The easiest method of setting the apparatus at the correct angle is to throw the screen image slightly out of focus by the arrangement previously described. The image of the thread form will then be bordered by a gray fringe which can quickly be made equal on each flank of the thread by adjusting the rays of the lamp and the condenser. When focus is again obtained, a sharp image of the screw thread is seen. The maximum field of the lenses that can be fitted is 1¾ inches in diameter, which makes it suitable for many profile plate gages as well as for the larger screw gages. In the case of ring screw gages, casts are taken in plaster-of-paris, and Fig. 5 shows such a cast mounted on a carrier which enables the profile of the thread to be brought quickly into the center of the field.

The Vertical Projector

The vertical projector was designed at the National Physical Laboratory especially for screw gage work, and it enables not only the form of the thread to be examined but with gages up to 2 inches in diameter, complete measurements can also be obtained. This machine is also manufactured by George Cussons, Ltd. As the enlarged image is produced on a table, which forms part of the machine, and all the mechanical movements and lighting controls are conveniently located, only one operator is required. Fig. 6 shows a general view of the machine set up for the examination of a screw plug gage, while Fig. 7 shows the optical arrangement. Light rays from an arc lamp are made

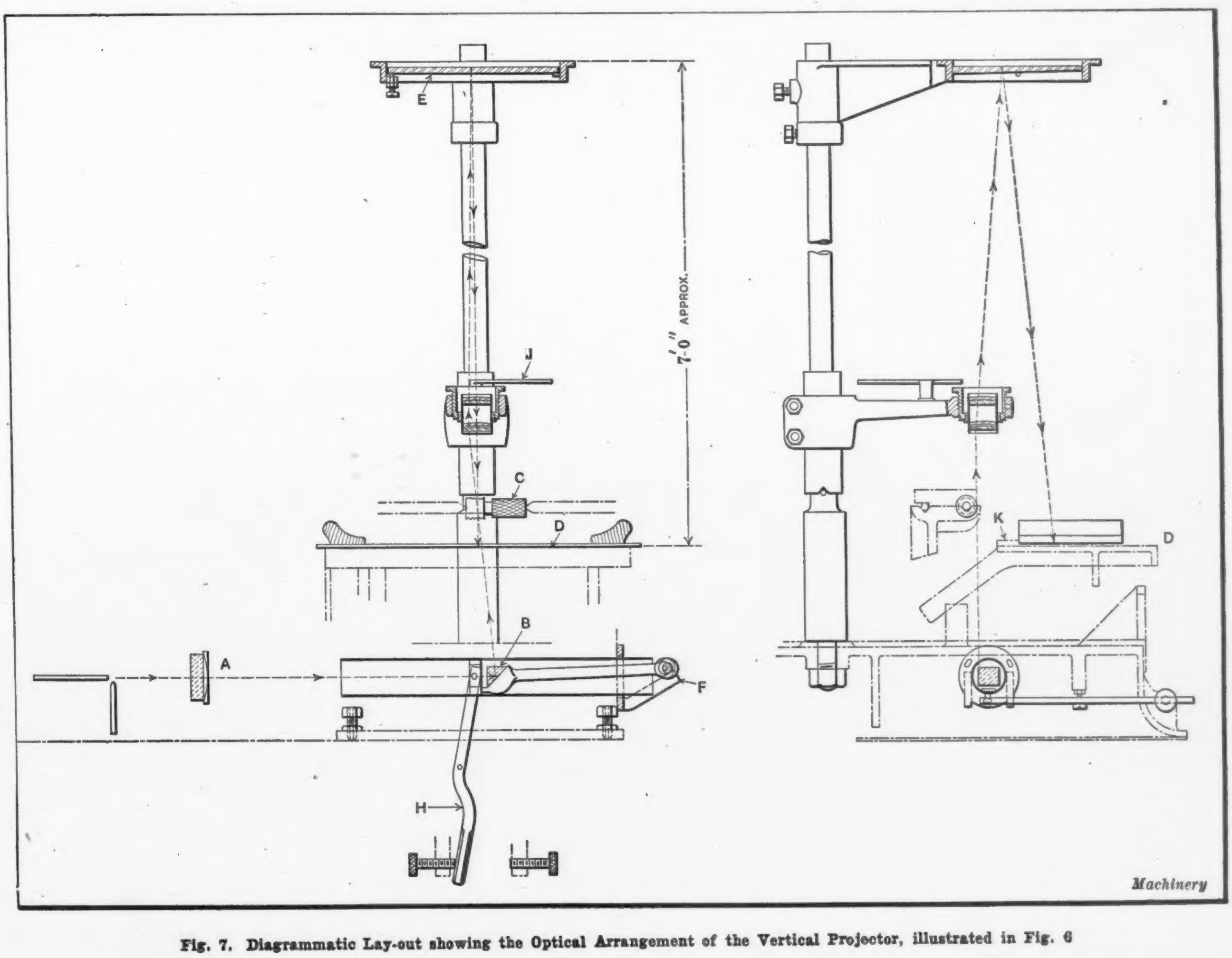


Fig. 7. Diagrammatic Lay-out showing the Optical Arrangement of the Vertical Projector, illustrated in Fig. 6

parallel by passing them through a condenser *A* and then into a tube arranged in the body of the instrument. The light, after passing through a reflecting prism *B*, passes upward, where part of it is interrupted by the thread profile of the gage *C*.

The light passing the profile now passes through a Dallmeyer kinematograph lens, which brings the silhouette image into focus at the desk *D* after reflection in the overhead mirror *E*, which is about 7 feet above the desk and is carried on a vertical pillar securely set in the bed of the machine. It will be seen that the prism *B* is set in such a position that the reflected parallel rays are not vertical, but at an angle corresponding to the helix angle of the thread gage under examination. The prism is carried on the end of a bar, the other end of which carries a roller, which runs up or down an inclined plane *F*. The inclined plane *F* determines the angular disposition of the prism *B*, and the pivoted lever *H*, shown diagrammatically, is moved between adjustable stops and slides the prism bar so that the prism is located at either side of and at the correct angle to the optical axis of the machine according to the direction of the helical angle of the screw gage. This direction varies for right- and left-hand threads and will change according to the side of the gage being examined.

The reflecting overhead mirror *E* is silvered on its upper surface; therefore two images are produced, a strong one being reflected from the silvered surface and a weak or ghost image from the under glass surface. To prevent confusion from the partial overlapping of the two silhouette images formed, the mirror is slightly wedge-shaped, being thinner at the front than at the back. In this way the ghost image is considerably deflected, and does not interfere with the image proper. The correct adjustment for lever *H* is obtained by first throwing the image of the profile slightly out of focus. This is effected by temporarily swinging a frame *J* carrying a set of long-focus lenses so that one of them is brought into the optical path. This allows approximately the correct angle to be obtained. The final setting is made by noting the center of the field on the desk when the object lens is swung out of the way, which may be easily seen since it is the brightest area. After replacing the object lens, the angle of rays is further adjusted in the out-of-focus condition until equal fuzziness on each flank of a thread is obtained at the center of the field. When the frame *J* is swung out of the way, the image is ready for inspection.

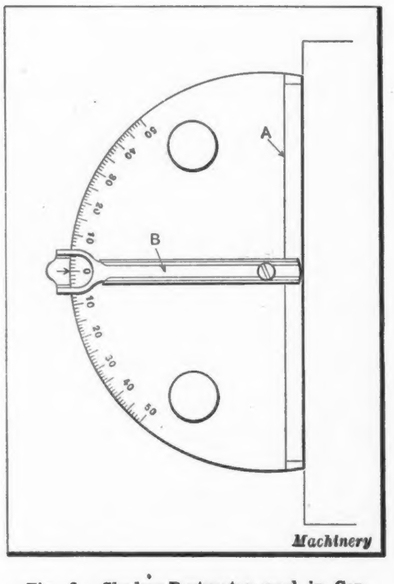


Fig. 8. Shadow Protractor used in Connection with the Vertical Projector

All the standard thread forms are printed enlarged fifty times on zinc plates, one of which may be seen in Fig. 6, from which it will be apparent that the diagram of the thread form is not a line but a band. This band is of equal width, ½ inch throughout in a diametral direction. Parallel bands ½ inch wide also appear, the upper and lower edges of which are in line with the crests and roots of the thread form, as indicated by the inner and outer edges of the wavy band. The bands on the diagram plate are dark gray instead of black and are approximately of the same shade as the silhouette of the image. The reason for this is that when the image of one part of the gage is fitted to a corresponding part of the thread band of the diagram, any excess metal in the gage at any point will cause an overlap of the image on the gray band and will give a deeper shaded area by superimposition. This condition would not occur, however, if the

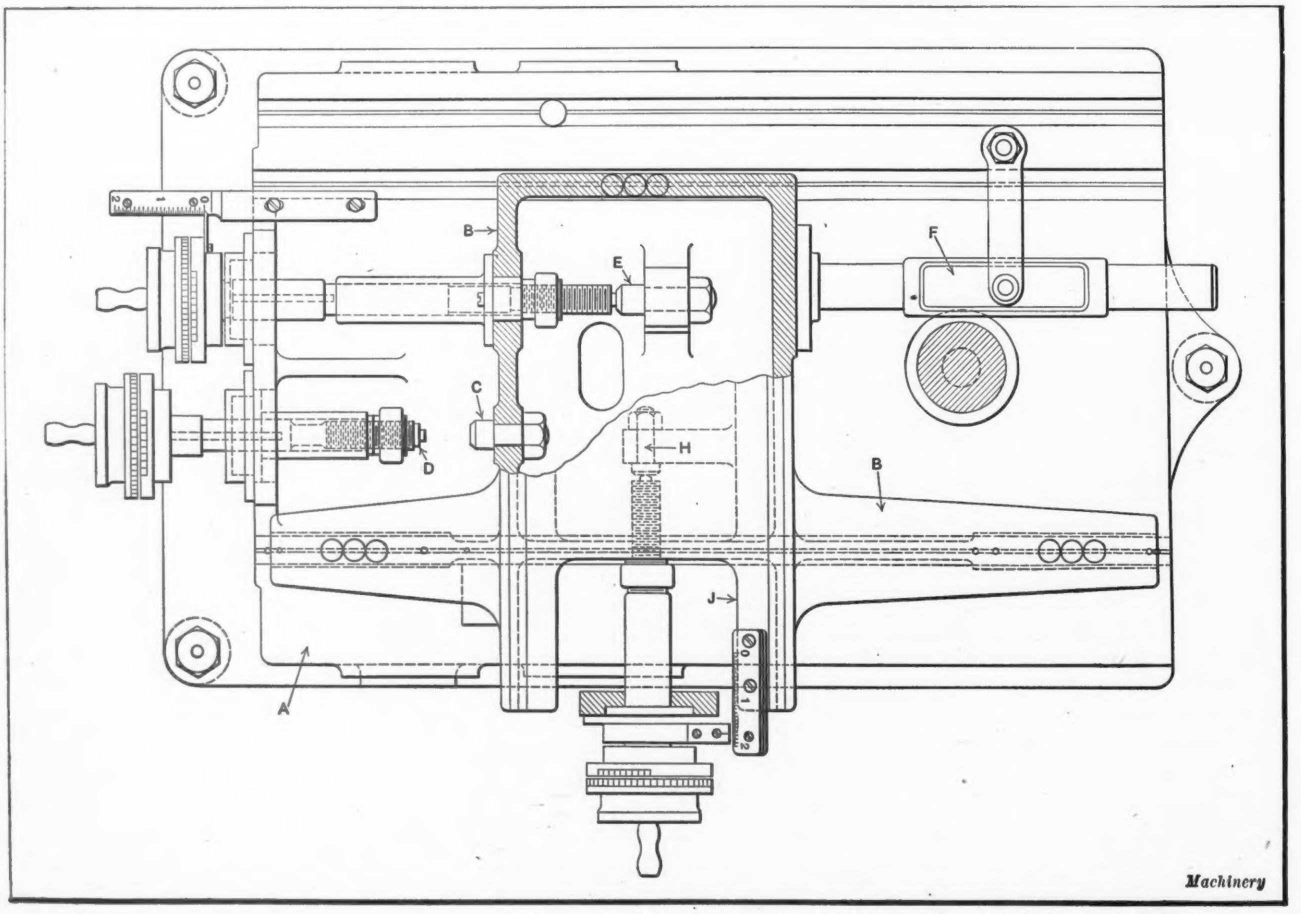


Fig. 9. View of Gaging Machine with Desk removed, showing Traveling Carriages and Micrometers used on Vertical Projector

band were black. Any insufficiency of metal at any part of the form is shown by a light streak or patch.

The angles of the thread are measured by means of the shadow protractor shown in Fig. 8. Referring again to Fig. 7, a bar *K* will be seen on the desk upon which the diagram plate bears. This bar extends the entire length at the rear of the desk and is pivoted at the right-hand end. At the left-hand end a hole in the bar fits an eccentric mounted on an upright, provided with a knurled knob which can be seen at *A*, Fig. 6. By rotating this knob the bar is rocked around its pivot to enable the diagram plate to be set so that the crests or roots of the silhouette image line up with the edge of the shadow of the bar *A*, Fig. 8, when the protractor is used. The gage carriage is then moved slightly in a diametral direction so that the image is cleared from the shadow of the straightedge *A*, Fig. 8. The radius bar *B* is then moved and the protractor slid along until the radius bar is parallel with one flank of the thread image, leaving a narrow slit of white between, so that readings can be taken in the regular manner.

The arrangements for moving the gage carriage axially and at right angles across the axes are shown in Fig. 9 which is a view of the gaging machine with the desk removed. The bedplate *A* is supplied with three leveling screws and carries an intermediate carriage *B* which is supported on three sets of three balls. These balls run in two V-grooves running at each side from the front to the back of the machine. On the long bearing side the intermediate carriage has an inverted V-groove which engages the two sets of balls, and the short bearing side has a flat under surface that engages the single set of balls. The intermediate carriage is thus mounted on a three-point support which allows it to travel in a straight line without restraint. Upon the intermediate carriage a sub-carriage is mounted similarly, but with a travel at right angles to that of the under carriage, and it is upon this sub-carriage that the centers for carrying the gages are mounted. The carriages, therefore, give true straight line motions to the gage in two directions at right angles in the same horizontal plane. The forward travel of the end carriage is limited by a stop *C*, which contacts with the head *D* of a micrometer screw whose nut is secured to the bed. The micrometer head projects conveniently at the front of the machine. The rearward travel of the carriage is limited by a stop *E* fixed to the bed. This stop contacts with the head of a micrometer screw whose nut is secured to the moving carriage, but whose spindle is carried freely through the front of the bed so that the graduated micrometer disk and handle are beside the other micrometer disk.

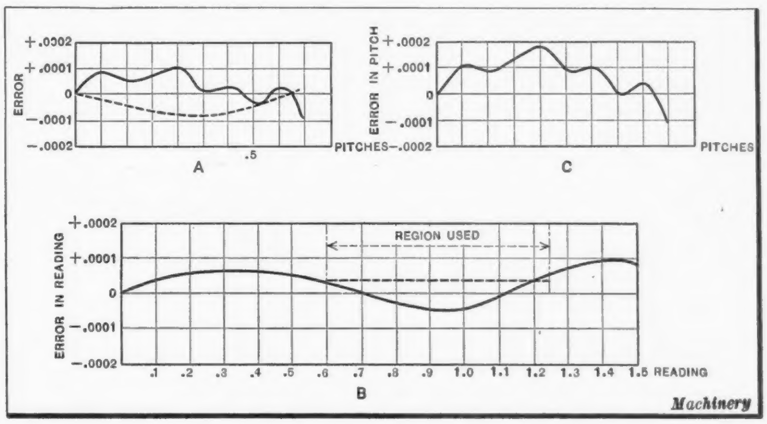


Fig. 10. Correction Curves for Thread Gage and Micrometer Screw

A weighted lever that can be seen on the right-hand side of the machine in Fig. 6, traverses the carriage between the limiting stops, the rapidity of movement being controlled by an oil dashpot *F*, Fig. 9. By operating the weighted handle, the gage is placed so that either its front or rear thread profile is projected on the desk. The axial travel of the gage carriage is limited by a stop *H* secured to the under carriage, and this stop contacts with the head of a micrometer screw whose nut is secured to the sub-carriage *J*. The sub-carriage is kept against the stop by a cord passing over a pulley and a weight.

To measure the pitch of a screw gage, the images of successive threads are brought into the same relative position on the same thread space of the diagram, the advancement required in each case being read off on the micrometer to 0.0001 inch. The means of two series of readings along the gage are taken, and the results plotted as shown at *A*, Fig. 10, in which the wavy line shows the errors either side of standard along the gage. If the micrometer screw of the machine were perfect this wavy curve would represent the corrections for the gage being examined, but usually the micrometer screw correction curve requires to be incorporated to obtain the true divergencies. Thus at *B* the complete correction curve for the pitch of the micrometer screw is shown, the region in use being transferred to the chart *A*. At *C* the combination of the two curves is shown.

To measure the outside and root diameters of a screw gage it is necessary first to mount on the machine a plain standard plug gage. The image of each edge of this plug gage is then brought successively, by means of the two micrometers in front of the machine, into coincidence with the edges of the bands on the diagram board of the screw which is to be tested, and the readings noted. The plug is now replaced by the screw gage and the crests of each side and then the roots of each side brought into coincidence with the bands as in the case of the plug gage. The micrometer readings, taken in conjunction with those obtained with the plug gage, give the dimensions for root and outside diameters. To facilitate the measurement of the pitch diameter a mark is made half way down the flanks of the threads in the magnified diagrams. These are useful if the flanks of the gage thread image do not lie parallel to the diagram, as then the flanks can be made to intersect half way down at the marks, and by rocking the carriage to view each side of the gage successively, the pitch diameter can be measured by the micrometer, the result being equivalent to measuring with wires in the thread vees with the exception that the reading in this case is obtained directly. All three inspection diameters can be measured to 0.0001 inch.

The next installment of this article, which will appear in the November number of MACHINERY, will describe the minimeter and the gage comparator used by the National Physical Laboratory for inspecting precision gage-blocks, by means of which readings to an accuracy of one-millionth inch can be made.

* * *

PATENTS ISSUED BY VARIOUS COUNTRIES

The table below gives the total number of patents that have been issued by the leading industrial countries up to the end of 1915. There are no statistics covering completely the number of patents issued since that date in some of the countries that were involved in the war:

	Patents
Austria-Hungary	156,975
Belgium	242,267
Canada	166,199
France	404,514
Germany	296,514
Great Britain	450,440
Italy	129,428
Norway	27,520
Russia	30,844
Spain	54,390
Sweden	41,588
Switzerland	72,275
United States	1,055,802
Total	3,128,756

Dies for Automobile Service Brake Covers

By J. BINGHAM, President, The B. J. Stamping Co., Toledo, Ohio

SIX punch press operations are required in the manufacture of a service brake cover for a certain type of automobile, which is of such shape that it seemed at first to be very difficult to produce. While four of the operations are performed on machines equipped with punches and dies of standard construction, such as have been described by the writer in previous numbers of MACHINERY, the remaining two require punches and dies of such an unusual design that a description of them will prove interesting. The appearance of the shell after the performance of each operation is shown in Figs. 1 and 2, in which the reference letters indicate the procedure of the successive operations. These illustrations give the dimensions of those portions of the shell that are changed in any of the operations, while the drawing of the completed shell, shown at *F*, Fig. 2, is fully dimensioned. The blank required for the production of this part is cut from cold-rolled stock 0.065 inch thick, and is 8¾ inches in diameter.

Blanking, Drawing, and Trimming Operations

The first operation consists of cutting the blank to the diameter stated, and then drawing it to the shape and dimensions shown at *A*, Fig. 1. The machine used for this operation is equipped with a combination blanking and drawing die. In the second operation, the dome of the shell is redrawn to a smaller diameter and the flange is bent back as shown at *B*. This shaping is accomplished by means of a drawing die, the punch and die being cut away suitably to permit the flange to be bent. The third operation is performed on a press equipped with a trimming die, and consists of cutting the edge of the flange to the diameter indicated at *C*.

Forming Punch and Die

The fourth operation consists of forming the shell to a conical shape, edging up the flange, and making a further reduction in the diameter of the small end. The appearance of the shell at the completion of this operation is shown at *D*, Fig. 2. It will be noted that the flange, conical portion, and diameter of the cylindrical portion at the small end, reach their final stage in this operation and remain unchanged during the succeeding ones. The punch and die used in forming the shell as mentioned may be seen in

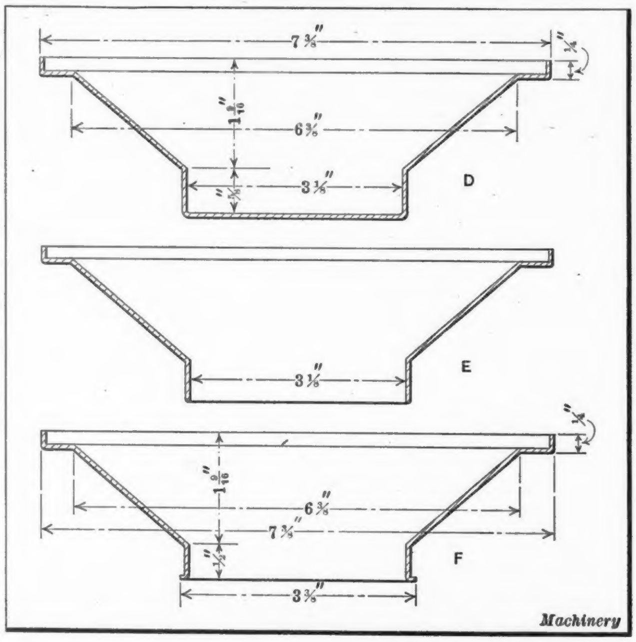


Fig. 2. Shell after Forming, Blanking and Edging Operations have been performed

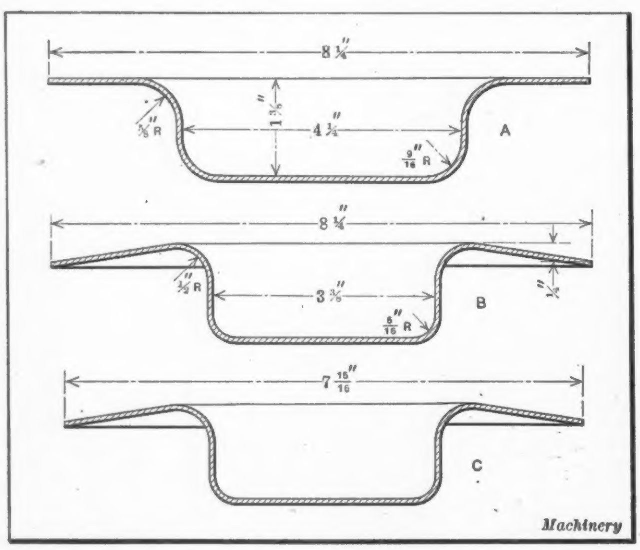


Fig. 1. Appearance of Shell after Blanking and Drawing, Redrawing, and Trimming Operations

Fig. 3, in which the punch is shown in the position it holds at the completion of the downward stroke of the press ram.

When the punch is withdrawn from the die, on the return stroke of the ram, rings *A* and *B* and part *C* are raised by springs, thus causing the finished shell to be ejected from the die. Rings *A* and *B* are then used in locating another unfinished shell in the die, preparatory to the next descent of the punch. Ring *B* is raised until a shoulder on the ring comes in contact with the under side of ring *D*, by means of coil springs placed in holes in base *E* which are arranged in a circle beneath ring *B*. Ring *A* and part *C* are raised through the medium of coil spring *F* which raises part *C* until a shoulder on the latter comes in contact with the lower surface of ring *A*, after which the two parts are raised together until the shoulder on ring *G* prevents ring *A* from rising further.

The shell is forced from the punch on the return stroke of the press ram by means of a mechanism which lowers ring *H* on punch *J* until the shoulders on the ring and the punch come in contact with each other. The mechanism that actuates ring *H* consists of knock-out rod *K* which forces bar *L* and pins *M* downward. The latter are screwed into the upper side of ring *H*. The method of arranging ring *H* on punch *J* insures the maintenance of the proper relation between the two parts. The stationary die rings *D* and *G* are each secured to base *E* by means of six fillister-head screws, while ring *N* is attached to punch-holder *O* in a similar manner. All the rings and contact faces of this punch and die are hardened and ground. It may be thought that this punch and die will not function properly due to the large number of moving parts contained in its construction; however, excellent and consistent results have been obtained through its use.

Final Operations on the Small End of the Shell

In the fifth operation, a hole is cut through the small end of the shell as shown at *E*, Fig. 2, a standard type of blanking die being used for this purpose. The next and final operation on the shell consists of bending back the edge

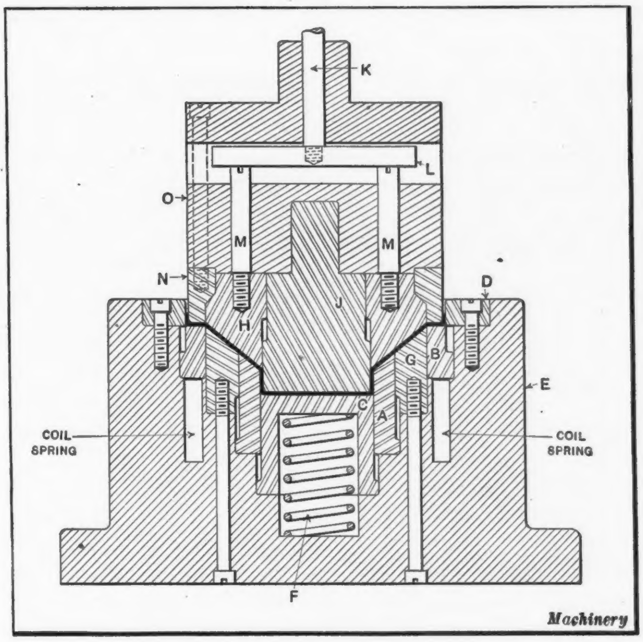


Fig. 3. Construction of Punch and Die employed in forming the Shell as shown at D, Fig. 2

formed by cutting the hole, as indicated at *F*. The punch and die used in performing this sixth operation is illustrated in Fig. 4, in which the punch is shown in its position at the end of the downward stroke. This die is of unusual construction, the part which supports the shell during the operation being made of two sections, one of which is shown at *A*. These sections pivot on pin *B*, and when closed together form an opening of the same size and shape as the outside of the shell after the preceding operation. The purpose of constructing the die in this manner is to permit the removal of the shell from the die after the edge on the small end has been bent back, this removal being readily accomplished after the die sections have been drawn apart. The function of pin *C* is to keep the ends of the die sections tight against plate *E* after they have been closed. The sections are retained in the closed position by suitable means which connect the jaw-like ends.

When the punch is withdrawn from the die, three compression coil springs *F* force plate *E*, and consequently the die sections, upward about 3/16 inch. This is enough to permit the shell to be placed in the closed die sections without the lower edge of the shell touching the bending groove on the die part *D*. The pressure of the springs is sufficient to hold the shell close against face *G* of the punch when the punch descends into the die. This insures that the shape of the body of the shell will remain unchanged as the shell is pushed down on part *D* and the edge is bent back. Part *D* is tapered slightly to allow the shell to be easily removed after the die sections are opened. Plate *E*, die-block *H*, and punch-holder *I* are made of cast iron, all the remaining parts being made of tool steel.

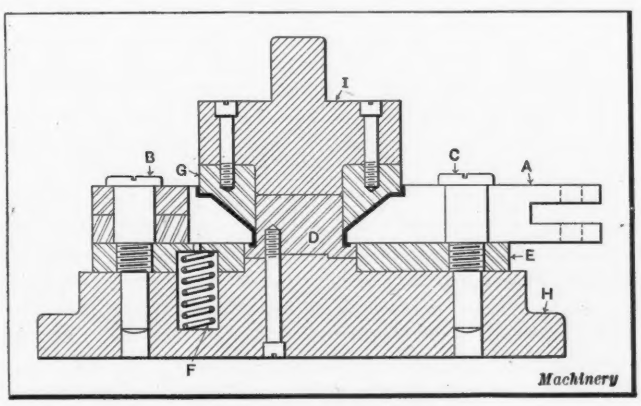


Fig. 4. Die provided with Two Members that can be swung aside to permit the Removal of the Shell

STANDARD TAPERS FOR LATHE AND GRINDING MACHINE CENTERS

Since making the discovery, in our own practice, of the remarkable results obtained by using high-speed steel for lathe and grinding machine centers and deciding to put them on the market with our line of lathe tools and machine dogs, we have found that one of the things that seemed to cause a great deal of trouble is the variety of tapers used for centers.

In general practice, it is customary to use Morse tapers for drilling machines, but when it comes to grinding machines and lathes, there seems to be a big diversity of opinion as to which is the best. Of ten large grinding machine manufacturers three use Brown & Sharpe tapers, three use Morse, and four use Jarno. In the case of lathes, out of thirty-three large concerns, twenty use Morse, one Brown & Sharpe, five Jarno, two Reed (which is a short Jarno), two modified Morse (longer than the standard Morse but the same taper), and three use tapers entirely of their own design.

We planned first to carry Brown & Sharpe and Morse tapers in stock. Later we found that we would also have to carry the Jarno taper, and now we find that we must also have the modified Morse taper, as this is used by the Hendey Machine Co. of Torrington, Conn. We also found that we had to carry the short Jarno taper, which is used by the Reed-Prentice Co. of Worcester, Mass. In addition to this, we find that there are a great many concerns who make centers for themselves from carbon steel, that do not seem to conform to any standard whatever.

It would seem to the writer that when anyone must use a taper center he should use one of the three standards, Brown & Sharpe, Morse, or Jarno. The last seems preferable, because its dimensions are easily remembered, and it has a standard taper throughout all sizes. The number of the taper indicates its length in half inches, the diameter at the large end in eighths of an inch, and the diameter at the small end in tenths of an inch. Take, for example, a No. 10 Jarno taper. The length is ten half inches, or five inches. The diameter at the large end is ten eighths or 1¼ inches, and the diameter at the small end is ten tenths or one inch. The taper is 0.600 to the foot and is the same for every number.

In the case of the Morse taper there are six different tapers per foot, every taper except Nos. 2 and 3 being different. The Brown & Sharpe tapers are all one-half inch per foot, except No. 10, which is 0.5161 inch per foot. Another difficulty about the Brown & Sharpe tapers is that there are more than two lengths of shanks for the same number in many instances.

It would seem that reference to these conditions may be of service to those who are considering establishing a taper of their own. It does not seem possible for all to adopt one standard at this time, as it would be too expensive for the larger manufacturers to make a change, but certainly, when anyone is designing a new lathe or deciding to use a taper shank of any kind, they should adopt some well-known standard.

Bridgeport, Conn. THOMAS FISH, President, The Ready Tool Co.

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An extended research on the subject of automobile steels has been carried out by the research committee of the Institution of Automobile Engineers of Great Britain. A report covering the investigation will be published and will contain a vast amount of information in regard to the physical properties of the ten automobile standard steels of which the specifications are given in the British Engineering Standards Association Report No. 75. The report may be obtained from the offices of the Institute of Automobile Engineers, 28 Victoria St., London, S.W., 1, England.

Manufacturing for Selective Assembly

Comparison of Interchangeable and Selective Assembly Manufacturing Methods—Dimensions and Tolerances on Drawings for Manufacturing on a Selective Assembly Basis

By EARLE BUCKINGHAM, Engineer, Pratt & Whitney Co., Hartford, Conn.

Selective assembly manufacturing is a method of manufacturing which is similar in many of its details to interchangeable manufacturing. In the selective assembly, the component parts are sorted and mated according to size, and assembled or interchanged with little or no machining. Because of their similarity, the two methods are often confused, and this has led to misapprehensions in regard to the principles of interchangeable manufacturing. The production of many commodities involves both methods of manufacture and this has led to even greater confusion. The general principles of both of these methods are compared in this article for the purpose of explaining the principles involved.

THE chief purpose of manufacturing, by selective assembly or interchangeable methods, is the production of large quantities of duplicate parts as economically as possible, within such limits that they may be assembled without further machining. In order to achieve this, close attention must be paid to the basic principles governing production, including the design of the mechanism and the process of manufacture.

The general principles of design are identical for manufacturing on an interchangeable basis and on a selective assembly basis. The functional design must first be made and tested, then the manufacturing design developed. This modifies the inventive design so that the product may be manufactured on a large scale in an economical manner. This subject of design was previously discussed in the September, 1919, number of MACHINERY. One point, however, should be kept constantly in mind. It is seldom that every part of a mechanism is to be made for selective assembly. Usually a very small percentage of the parts are so made.

A model mechanism is the representation of the design in metal. Thus, as with the design, the general principles and purposes of the model are identical for both interchangeable and selective assembly manufacturing. The purposes of models were discussed in the October, 1919 number.

Clearances and Tolerances in Selective Assembly Manufacturing

The matter of clearances and tolerances is quite different when manufacturing on an interchangeable basis from when manufacturing on the basis of selective assembly. In interchangeable manufacturing, the minimum clearances should be as small as the assembling of the parts and their proper operation under service conditions will allow. The maximum clearances should be as great as the functioning of the mechanism permits. The difference between the maximum and minimum clearances establishes the sum of the tolerances on the companion surfaces.

However, when this allowable difference is smaller than normal manufacturing conditions will permit, parts cannot be economically manufactured on an interchangeable basis. In such cases one of two courses is open. First, excess metal may be left on one part which is fitted at assembly—this usually proves an expensive process; or second, tolerances can be established which enable the parts to be manufactured economically and then sorted and assembled according to their size. This second method is known as selective assembly manufacturing. There are several methods of attaining this end. In general, the usual method consists of treating the more intricate companion parts like interchangeable parts; that is, making the basic dimensions on one part represent the maximum metal conditions, and having the tolerances define the minimum metal conditions. The extent of the tolerances, however, will be determined by the extent of the normal manufacturing variations. The basic dimensions of the companion part would represent the minimum metal condition—not the maximum metal sizes as in interchangeable manufacturing—and the direction and extent of the tolerance would be identical with the first piece.

The practice, which is correct for selective assembly, of making the tolerances represent the normal variation of the manufacturing process employed, is often mistakenly used when manufacturing on an interchangeable basis. If such a practice adds nothing to the expense of production, there is no harm in employing it; but too often it imposes unnecessary refinement in manufacture, as in almost every case, the closer the tolerances, the more exacting and expensive will be the manufacturing processes. With selective assembly manufacturing, on the other hand, the closer the tolerances, the fewer the subdivisions in size that will be required, and the smaller the stock of parts it is necessary to carry. This introduces a factor in selective assembly manufacturing which is not present in interchangeable manufacturing. The economical balance between the increased cost of manufacturing to closer tolerances and the decreased cost of investment represented by a smaller stock of different sized parts establishes the proper course to follow when manufacturing on the basis of selective assembly. Ultimate economy here, as elsewhere, is the main end sought.

Dimensions and Tolerances on Component Drawings

Many of the general principles in regard to component drawings for parts made for selective assembly are the same as for interchangeable parts. Several details vary, however, due to the differences in treating the clearances and tolerances. In both cases the effort should be made to so give the dimensions and necessary tolerances on the drawings that it will be possible to lay out one, and only one, representation of the maximum metal condition and one, and only one, minimum metal condition. In addition to this, for selective assembly, some notation must be made to indicate the proper grading and classification according to size. Thus, in selective assembly manufacturing, there will be a double set of limits, the first being the manufacturing limits, and the second the assembling limits.

Take, for example, the stud and hole shown in Fig. 1, which give the proper assembling conditions. The minimum clearance is 0.0000 inch while the maximum clearance is 0.0004 inch. Assume that the normal manufacturing variation on each part will be 0.0010 inch. Fig. 2 gives one method of notating both sets of limits. Any studs in Group A, for example, will assemble in any hole in Group A, but the studs in one group will not assemble properly in the holes in another group. The above example shows one method of grading parts when both of the companion parts are to be sorted before assembly. Many times in actual practice, when one of the parts is complicated, and the majority of its surfaces are interchangeable ones, the minor part only is sorted according to size. In such cases, instead of defining grades for the major part, a note to the following effect is substituted, "Select stud to suit at assembly."

In many cases, two separate drawings are made of a part which is to be graded before assembly. One shows the manufacturing tolerances only, so as not to confuse the machine operator, while the other gives the proper grading information. In an article entitled "Component Drawings for Interchangeable Manufacture," published in the November number, five laws of dimensioning were given for interchangeable parts. All of them, except the third, apply equally to parts which are selectively assembled. The laws which apply to this method of manufacture will be given again.

Laws of Dimensioning when Manufacturing for Selective Assembly

1. In manufacturing, there is only one dimension (or group of dimensions) in the same straight line which can be controlled within fixed tolerances. This is the distance between the cutting surface of the tool and the locating or registering surface of the part being machined. Therefore, it is incorrect to locate any point or surface with tolerances from more than one point in the same straight line.

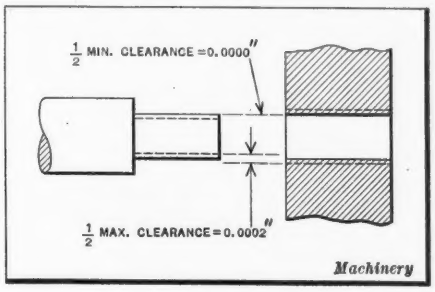


Fig. 1. Proper Assembling Conditions in Selective Assembly

2. Dimensions should be given between those points which it is essential to hold in a specific relation to each other. The majority of dimensions, however, are relatively unimportant in this respect. It is good practice to establish common location points in each plane, and to give, as far as possible, all such dimensions from these common location points.

3. This law relates to the proper basic dimension to be given on the component drawing. In selective assembly the conditions which must be met are so different, that no general rule in this respect can safely be given. Each case requires special consideration.

4. Dimensions must not be duplicated between the same points. The duplication of dimensions causes much needless trouble, due to changes being made in one place and not in the others. It causes less trouble to search a drawing to find a dimension than it does to have them duplicated and more readily found but inconsistent.

5. As far as possible, the dimensions on companion parts should be given from the same relative locations. Such a procedure assists in detecting interferences and other improper conditions.

Similarity of Specifications, Equipment, Gages, and Inspection Methods

The general principles of specifications for interchangeable manufacture, which were given in the March number, hold true for manufacturing on a selective assembly basis. Particular care should be taken to specify clearly the parts to be so manufactured and the method of grading to be followed. If the component drawings are properly made, there is no difference in the actual productive operations between manufacturing on an interchangeable and on a selective assembly basis. In both cases, the task is to produce parts within specified tolerances. Therefore, the conditions governing the design of the manufacturing equipment are constant.

The working and shop inspection gages for either interchangeable parts or those made for selective assembly are similar. Additional gages for the purpose of grading, however, are required for the final inspection. Often these are indicator gages, which promote the rapid sorting of the product. In other cases, gages with successive steps or with slightly tapered measuring surfaces are used.

The detailed shop inspection differs in no particular from that employed in interchangeable manufacturing. The only difference is the addition of the selection and grading of the parts after completion. Sometimes the actual selection takes place at the assembly itself. If the first part tried is too large or too small, another is chosen which assembles properly. If the rate of production is relatively low, this procedure is often satisfactory. In fact, it is often observed in the assembly of parts which are supposed to be interchangeable. But if the production is high, too much time will be lost by the assembler to make the practice economical.

In general, manufacturing on an interchangeable basis will be found more economical than manufacturing on a selective assembly basis, provided the design permits sufficient clearances to allow reasonable manufacturing tolerances. In the first place, a larger stock of parts is required for selective assembly to insure that companion parts of suitable sizes will always be available. In the second place, the additional expense of sorting, whether done by an inspector or by the assembler, is involved in this method of manufacture. In its actual operation, the main difference between selective assembly and interchangeable manufacturing is that overlapping tolerances are required in selective assembly while such tolerances are absolutely wrong in interchangeable manufacturing.

* * *

BRITISH MACHINE TOOL IMPORTS AND EXPORTS

The imports of machine tools into Great Britain during the first six months of this year had a value of nearly £1,600,000 or at present exchange, about $6,000,000. For the corresponding six months in 1919 the value was £2,250,000 or over $8,000,000. In 1914, during the corresponding six months, which was previous to the war, the imports amounted to only £215,000, or at the exchange value at that time, about $1,050,000. The exports of machine tools from Great Britain during the first six months of 1920 had a value of £1,200,000, or about $4,500,000. This is an increase of 50 per cent over the exports for a similar period in 1919.

Generally speaking, the imports today are three times the imports previous to the war on the basis of quantity, and seven times the imports on the basis of value. The exports are slightly larger than the pre-war exports in quantity, and about two and one-half times as large as the pre-war exports in value. It is significant that the exports are steadily growing, while the imports are decreasing.

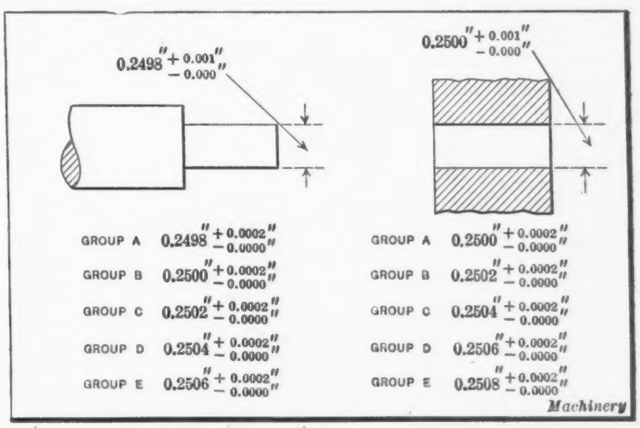
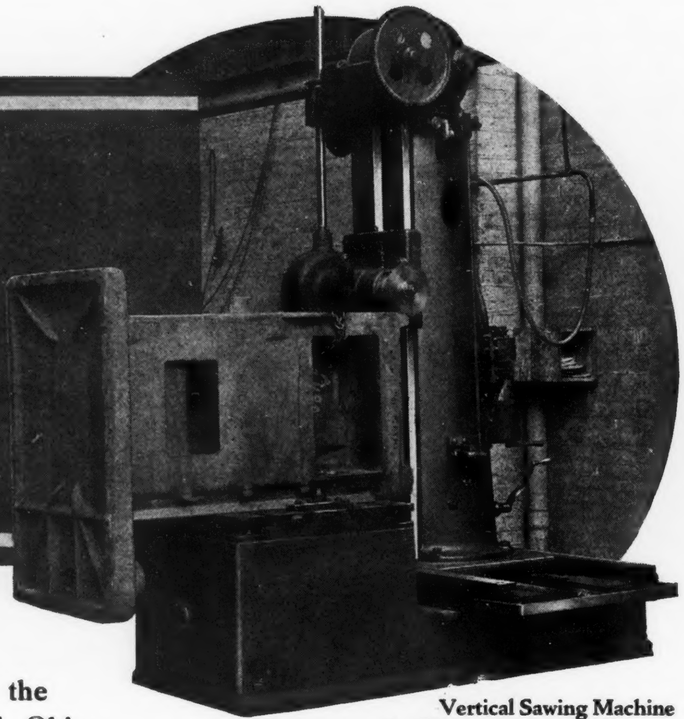


Fig. 2. Information placed on Drawings used in Selective Assembly Manufacturing to facilitate the Grading of Parts

During the month of June the imports of machine tools from all countries into Great Britain amounted to £340,000, at present exchange equal to about $1,300,000. The exports of machine tools from Great Britain amounted to about £265,000 or about $1,000,000. The largest item in the exports is represented by lathes, the value of the exports being about $400,000. The largest imports were drilling machines valued at about $360,000.

Special-Purpose Machines in the LeBlond Plant



Vertical Sawing Machine for Milling Machine Columns

Design and Construction of Machines Employed for Special Purposes in the Shops of the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio

FREQUENTLY a special-purpose machine proves itself superior to a standard type of machine tool for some unusual operation. Sometimes there is no machine on the market that is particularly adapted for handling a certain class of work; again, the general design of a standard machine may be suitable, but the size of the work to be done may be such that a special machine is preferable. If there is enough work to be done of a special nature, a special machine, then, will prove a valuable addition to the shop equipment. It is not always necessary, however, to construct an entirely new machine, because a standard machine can frequently be modified by the use of attachments to perform special operations. The present article deals with several special machines used by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, that have either been entirely built by the company, or modified by means of attachments and reconstruction to meet special conditions in the LeBlond plant. The reason for building these machines was that there were no standard machines on the market specifically suited for the class of work for which these machines are used.

Vertical Sawing Machine Built for Operation Customarily Performed on Radial Drilling Machines

The machine shown in the heading illustration and also in Fig. 1 is a vertical sawing machine designed for splitting the support provided on the top of milling machine columns for the overhanging arm. Ordinarily this operation is performed on a radial drilling machine, the slitting saw being attached in a horizontal position to the drill spindle and fed the length of the overhanging arm support by moving the spindle head outward along the radial arm of the machine. However, this is a class of service for which a machine of this type was never intended and for which it is not suited on account of the side strains to which the spindle is subjected. There being no other machine on the market better adapted for performing this operation, the special machine described was built.

Reference to the heading illustration will make clear the manner of mounting the work on the table of the machine, the slitting operation being performed by feeding the cutter-head downward. A five-horsepower variable-speed motor mounted on the top of the column furnishes the power for driving the cutter-spindle and for feeding or reversing the cutter-head. An automatic control manufactured by the Electric Controller & Mfg. Co. is supplied for the motor. By referring to section *X-X*, Fig. 1, it will be seen that a pinion mounted on the motor shaft drives a large spur gear on one end of the shaft *A*. At the opposite end of shaft *A* is mounted a bevel pinion which engages with a gear mounted on sleeve *E*, section *Y–Y*, to which the worm-shaft *B* is keyed, but through which it is permitted to slide as the cutter-head *D* is raised or lowered. A bevel pinion keyed to the lower end of shaft *B* drives the large gear shown at the left-hand end of the cutter-spindle *C*, section *Z-Z*. The slitting saw is attached to the right end of this spindle.

Arrangement for Feeding and Reversing the Cutter-head

The lowering and raising of the cutter-head *D* is effected through worm threads cut on the sleeve *E* previously referred to, which drive worm-wheel *F*. On the same shaft with this worm-wheel is mounted a small spur gear *G* which drives a large gear *H* keyed on the left end of shaft *I*. This shaft drives shaft *J* by means of a sleeve to which both shafts are keyed but in which the left end of shaft *J* is a sliding fit. Two bevel pinions *K*, one for feeding and one for reversing the cutter-head, are mounted on shaft *J*, either one of which can be meshed with the gear on the upper end of the feed-screw *L*. The feed-screw is provided with left-hand threads for almost its entire length, which pass through the nut *M* attached to the back of the cutter-head *D*. This arrangement permits the cutter-head to be raised or lowered as desired, depending upon which pinion *K* is placed in mesh with the bevel gear on the top of the feed-screw.

Gears *G* and *H* have 18 and 51 teeth, respectively, and when arranged as shown, the feed of the cutter-head is 0.015 inch per revolution of the cutter-spindle. When they are reversed, the feed is 0.125 inch per revolution of the spindle. Through the use of another set of change-gears having 29 and 40 teeth, respectively, feeds of 0.031 and 0.062 inch per revolution of the spindle can be obtained. The sidewise operation of shaft *J* is accomplished by means of the mechanism shown at *N*. The handle on this device is provided with a locking spring pin which may be inserted in one of three holes in the bracket which supports the device. These holes are located so as to permit either of pinions *K* to be locked in mesh with the gear on the feed-screw, or to hold them both in a neutral position. The heading illustration shows a modification in this feature of the machine. In this illustration the control of the mechanism is placed near the bottom of the column so that it will be convenient for the operator, and it is connected by means of a long rod with a lever on shaft *O*, Fig. 1.

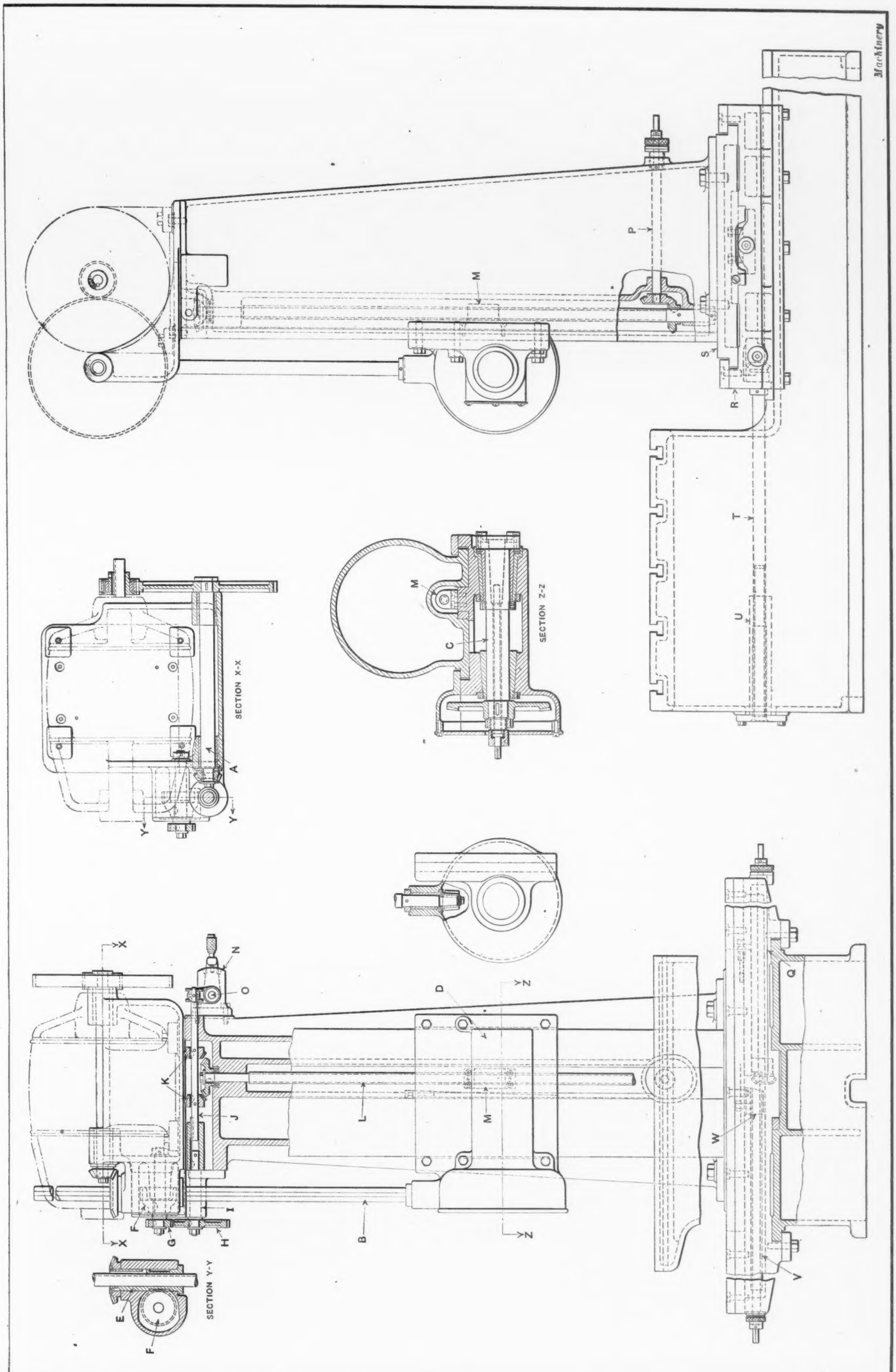


Fig. 1. Assembly Drawing of Sawing Machine shown in Heading Illustration

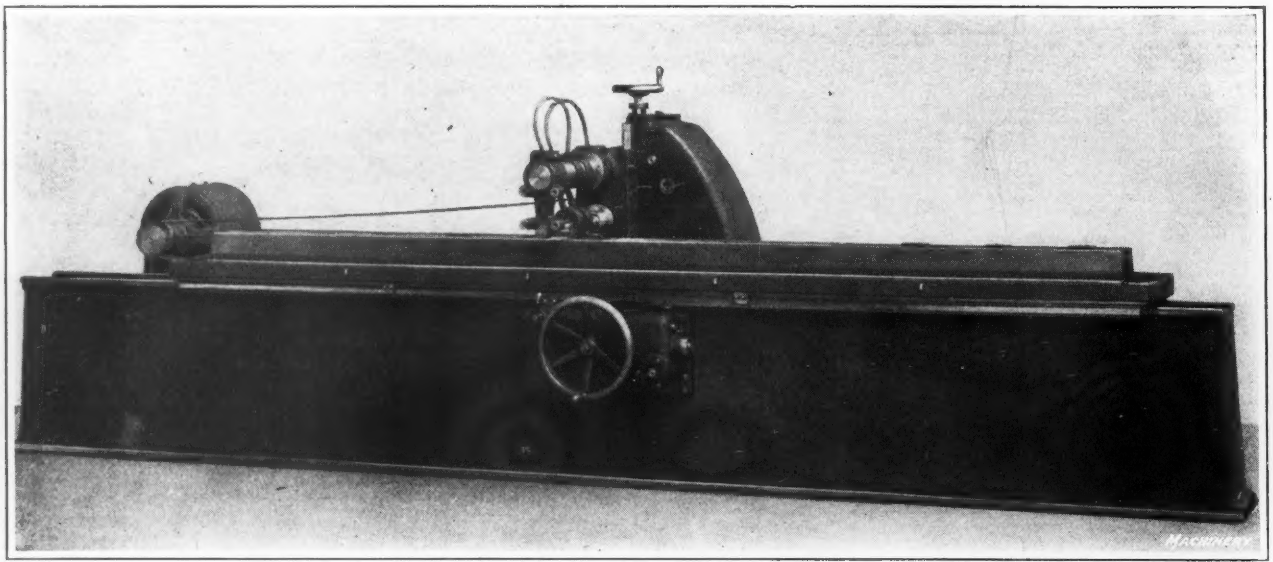


Fig. 2. Machine built for milling Keyways in Long Shafts

The cutter-head can also be fed or raised by hand when pinions *K* are in a neutral position, through revolving shaft *P* in the lower portion of the column, by means of a crank-handle placed on the square end of this shaft. It is obvious that the bevel gear at the opposite end of the same shaft drives the gear near the bottom of the feed-screw, thus rotating the feed-screw, which causes the cutter-head to be operated in the manner previously described. It will be noted that a ball bearing is placed beneath the bevel gear on the upper end of the feed-screw.

Lateral and Transverse Adjustments of the Column

A comparison between the heading illustration and Fig. 1 will show a slight difference in the construction of the table. In the heading illustration a special casting having a series of T-slots on its upper side running at right angles to each other, is bolted to the built-up portion of the base. No special casting is shown in Fig. 1 and the T-slots run only in a lateral direction. The discrepancy between the two illustrations is due to the drawing not having been changed to suit the machine as finally built. Provisions have been made for adjusting the column of the machine by hand in both transverse and lateral directions to suit the work. The transverse adjustment is obtained by rotating shaft *Q* which is supported in bearings in lugs cast on base *R*, through the medium of a crank-handle placed on the square end of the shaft which projects beyond the side of base *R*. At the opposite end of this shaft is a miter gear that meshes with a similar gear on shaft *T*. This shaft is attached to base *R* at right angles to shaft *Q* and extends forward into the built-up portion of the base. The front end of the shaft is provided with threads that engage with nut *U* bolted to the front end of the base. Thus as shafts *Q* and *T* are revolved, shaft *T* is either advanced into nut *U* or expelled from it, at the same time imparting a similar movement to the column through bases *R* and *S*.

Lateral adjustment of base *S*, and therefore of the column, is obtained by turning screw *V*, which extends across the entire width of base *R*. This screw is shown broken off near the center of the front view of the machine in order to clearly show the mechanism employed in obtaining the transverse adjustment of the column. The end of screw *V*, which is not shown in this view, is of the same construction as the end shown, so it is apparent that the screw can be turned from either side of the machine through the use of a crank-handle. The screw passes through a nut *W* bolted on the under side of base *S*, near the center, and as the threads of the screw engage with those of the nut when the screw is rotated, base *S* and the column are adjusted laterally. Attention is called to the flat bar guard shown in the heading

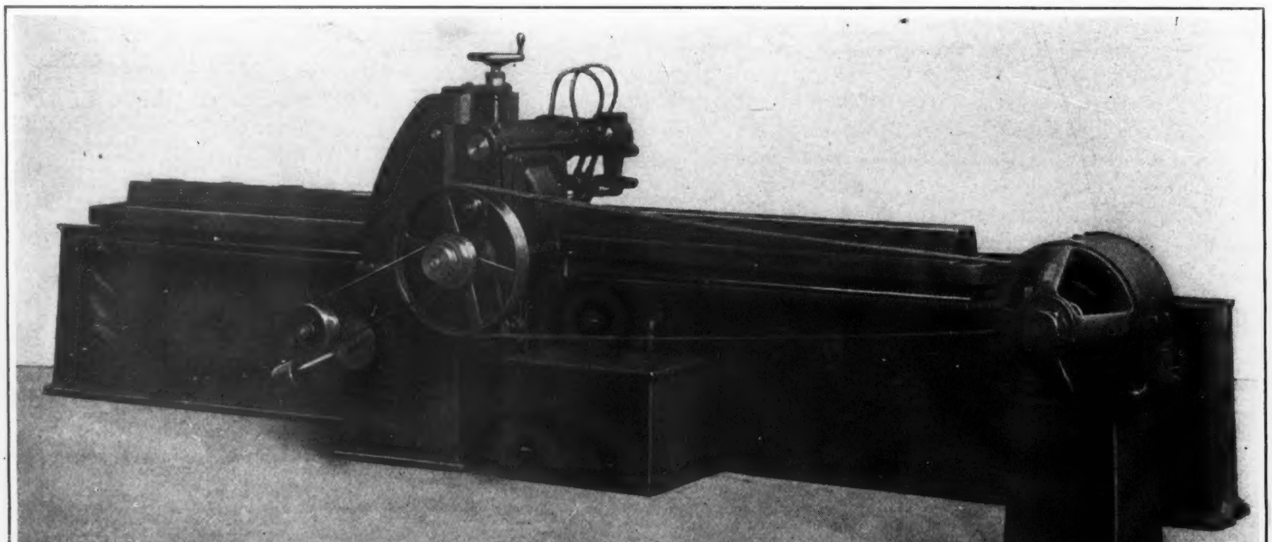


Fig. 3. Rear View of Special Keyseating Machine shown in Fig. 2

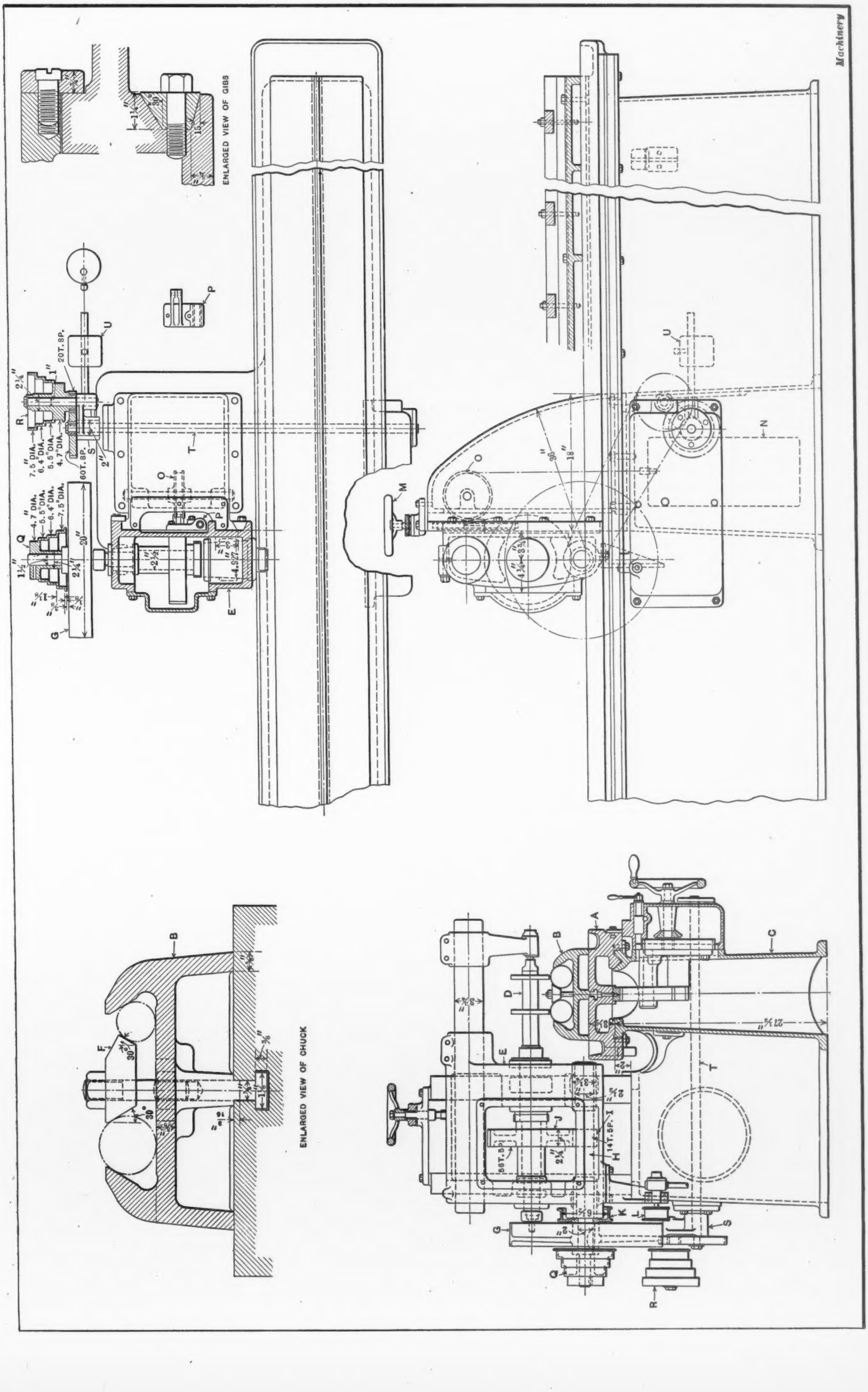


Fig. 4. Construction and Important Details of Keyway Milling Machine shown in Figs. 2 and 3

illustration, which was provided to protect the ends of shaft Q and screw V from injury. This guard is raised when an adjustment of the column is necessary so that a crank-handle can be placed on either the shaft or screw to accomplish this purpose.

While the machine was designed especially for the work previously mentioned, it can be employed for operations that are slightly different. Arrangements could be made to modify the bottom of the column and base S to permit the column to be swiveled on the base. This would allow the cutter to be applied in an angular relation to the work.

Special Keyseater for Long Shafts

Figs. 2 and 3 show the front and rear views of a planer type of milling machine which was designed for milling keyways in long shafts from ¾ to 3 inches in diameter, without necessitating resetting the work. One or two shafts are milled at a time, although the machine could be arranged for milling a larger number simultaneously. When two shafts are being machined, gang cutters are used. In this case there was a machine on the market that could have been utilized for the work, but it was especially suited for larger work and would have been more expensive than the special machine here described.

The construction and operation of the keyseater will be more readily understood by referring to Figs. 4, 5, and 6. In Fig. 4 it will be seen that a table A on which is mounted a chuck B for holding the work, is supported on a long bed casting C. A mechanism is provided for traversing the table and chuck past the cutters mounted on arbor D which is held in cutter-head E. The outer end of arbor D is supported by an overhanging arm, which also extends from the cutter-head. The latter is attached to a column cast integral with the bed near its center, on which the cutter-head can be raised or lowered in order to bring the cutters into contact with the work. The gibs used for holding the cutter-head to the column are shown in detail in the upper right-hand corner of the illustration.

Chuck B is of the same length as the planed upper surface of table A. The width of the chuck varies with the diameter of the work for which it is adapted. Thus the chuck suitable for holding work from ¾ to 1⅛ inches in diameter is 6½ inches wide, the chuck for work from 1¼ to 1⅞ inches in diameter is 9 inches wide, and the chuck for work from 2 to 3 inches in diameter is 12 inches wide. Means for clamping the work are provided at regular intervals along the length of the chuck. An enlarged sectional view of the chuck suitable for work from 1¼ to 1⅞ inches in diameter is shown in the upper left-hand corner of the illustration. This view also shows the method employed in securing the chuck to the table and the clamping arrangement provided for holding the work. It will be apparent that clamp F must be changed whenever work of a different size is to be machined. The chuck could readily be modified to permit the milling of more than two shafts at a time, by increasing its width and providing several rows of clamps and clamping bolts. In such a case, a sufficient number of cutters would need to be provided on the arbor of the machine to suit the number of shafts in the chuck.

Cutter Drive and Method of Feeding Cutter-head

The machine is driven by a variable-speed motor mounted on a base placed a certain distance away from the bed (see Fig. 3) in order to bring the motor pulley in line with pulley G of the machine, Fig. 4, which is mounted on shaft H. This shaft is provided with gear teeth at I which mesh with gear J on the cutter-spindle. The maximum spindle speed obtainable by means of the motor furnished is 130 revolutions per minute, the minimum speed being 43 1/3 revolutions per minute. Pulley K on shaft H is connected by a belt to the pump pulley L. The pump is fastened to a bracket bolted to the under side of the cutter-head, and is raised or lowered with the cutter-head so that the proper distance between the two pulleys is maintained. The tank which contains the lubricant is placed at the rear of the machine as shown in Fig. 3, in which the piping to the pump and cutters can also be seen.

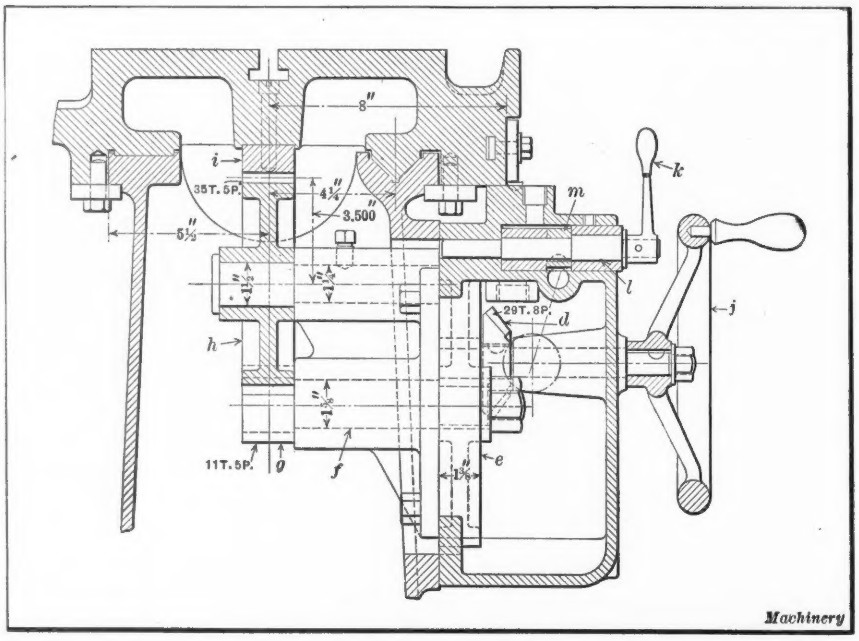


Fig. 5. Sectional View through Feed Control Box, and Portion of Gearing employed in driving the Table of Keyway Milling Machine

The feeding of the cutters into the work or their removal from the work is obtained by altering the position of cutter-head E on the face of the column. This is accomplished by revolving handwheel M, which is keyed on a screw that passes through a tapped hole in a bracket P bolted to the back of the cutter-head. The counterweight N, which is contained inside the column, is provided to balance the cutter-head, being connected to the latter by a chain that passes over pulley O and is attached to bracket P.

Table Driving Mechanism

The power for driving the table is transmitted from the driving shaft H by a belt running between cone pulleys Q and R. As cone pulley Q is raised or lowered when the position of the cutter-head is altered, it is obvious that it is necessary to furnish means for permitting cone pulley R to adjust its position to suit the position of pulley Q. This is accomplished by placing pulley R on a fixed stud held in the arm of bracket S, which is mounted on the end of shaft T and on which it is permitted to swivel. On the inner end of pulley R is a small spur pinion which drives shaft T by meshing with a gear on this shaft. Thus, when the cutter-head and pulley Q are raised, the pull of the belt between the cone pulleys causes the small gear on pulley R to advance on the gear in shaft T so that the proper distance between the two pulleys is maintained. Bracket S is also provided with a lug in which is screwed a rod for supporting weight U. This weight is heavy enough to hold pulley R tight against the belt and also causes the small pinion on this pulley to recede on the gear on shaft T when pulley Q is lowered.

The arrangement employed for transmitting motion from shaft T to the table can be understood by referring to the front and sectional views of the feed control box which are shown in Figs. 5 and 6, where it will be seen that a worm W, mounted on the front end of shaft T, drives a worm-wheel Y keyed on a sleeve which is a loose fit on shaft a. One side of the worm-wheel is provided with clutch teeth

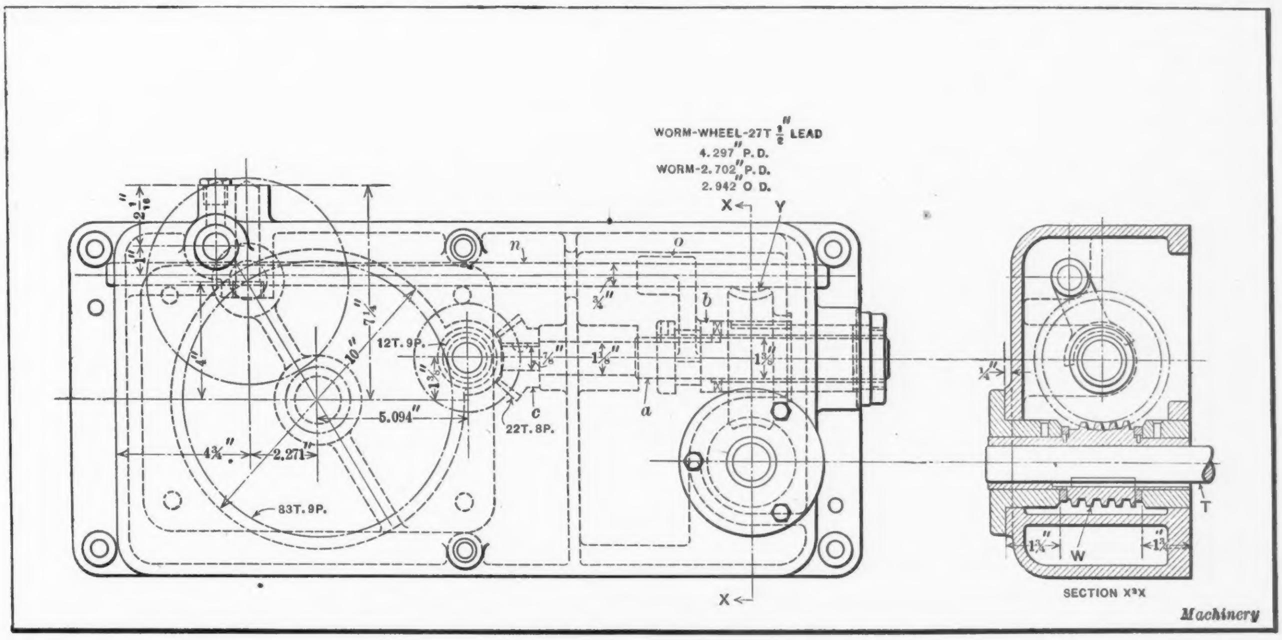


Fig. 6. Elevation and Sectional Views of Feed Control Box containing Part of the Mechanism and Clutch for operating the Table of Keyway Milling Machine

for driving clutch *b* when the teeth of the latter are brought in mesh with those of the worm-wheel. As the clutch is keyed on shaft *a*, the rotation of the shaft is effected when this occurs. Bevel pinion *c*, which is also mounted on shaft *a*, drives gear *d*, Fig. 5. Spur gear teeth are cut on the hub of the latter, and these engage with gear *e* on shaft *f*. The spur gear teeth which are cut on the opposite end of this shaft at *g* drive gear *h* which, in turn, meshes with rack *i* on the lower side of the table and thus accomplishes the feeding of the table. When the cutter-spindle is revolving at its maximum speed, or 130 revolutions per minute, the four feeds of the table obtainable through cone pulleys *Q* and *R*, Fig. 4, are 2.92, 4.11, 5.32, and 7.47 inches per minute. When the cutter-spindle is revolving 43 1/3 revolutions per minute the range of feeds is 0.98, 1.37, 1.77, and 2.49 inches per minute.

The return of the table to its original position after an operation has been performed is obtained by first placing

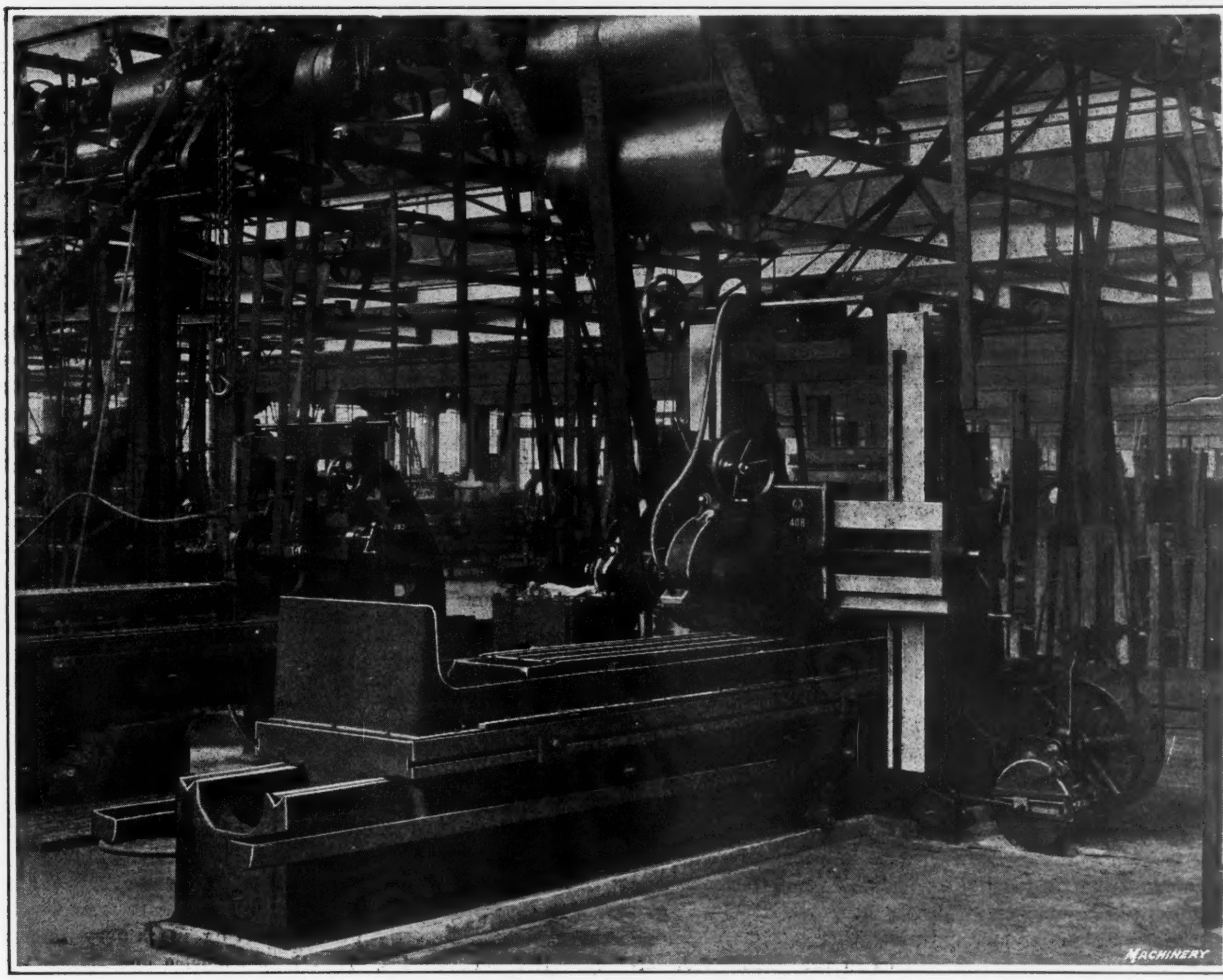


Fig. 7. Planer adapted for grinding Large Flat Surfaces

worm-wheel Y, Fig. 6, and clutch b out of mesh and then turning handwheel j, Fig. 5, in the proper direction. This handwheel is mounted on the same shaft on which bevel gear d is keyed, and from this junction the mechanism used in reversing the table is the same as that used in obtaining its feed. The operation of clutch b is secured by turning handle k which is mounted on shaft l. A small spur pinion m on this shaft engages with teeth cut on the operating rod n, Fig. 6, on which the clutch arm o is pinned. Thus rod n is carried to and fro when handle k is operated.

Medium-sized Planer Equipped for Performing Surface Grinding Operations

Fig. 7 shows a 36- by 36-inch by 14-foot Gray planer rigged up for the grinding of large flat surfaces such as milling machine tables, compound rest parts, vise jaws, etc., in order to eliminate the hand scraping of these surfaces when the parts are being assembled. The special equipment on this planer consists of a grinding wheel head, a special fine-pitch cross-feed screw, special elevating screws, a special countershaft and idler pulley for driving the pulley on the grinding wheel head, equipment for supplying water to the grinding wheel, and a guard bolted to the sides and ends of the table in order to prevent the water that is fed to the grinding wheel from splashing on adjacent parts of the machine and the floor.

The machine reciprocates the work automatically beneath the grinding wheel, the table being operated by the same means as are employed when the planer is used on planing operations, the return of the table being faster than its forward movement. The special cross-feed screw permits the grinding wheel to be fed transversely from a few thousandths inch to nearly the full width of the wheel. The special elevating screws permit vertical adjustment. The countershaft and idler furnished for driving the wheel-head pulley permit the driving belt to move across their faces as the wheel-head is traversed across the work.

* * *

ACTIVITIES IN LOCOMOTIVE BUILDING

During the war a great many locomotives were used until they had to be discarded, and in all countries of the world there is at present a scarcity of locomotives. Germany had to give up a large number of her engines to Belgium and France, and with the exception of Russia, where conditions are not known, it is likely that Germany is in greater need of locomotives than any other country. France is also in great need of locomotives, and on the French railways many German, as well as English and American, engines are now in use. Both in England and the United States there is a need for more engines, which in both of these countries will be supplied through their own locomotive works. Japan now builds some of her own locomotives, and Holland during the war engaged in this line of endeavor also. For a long time to come France will be unable to fill her requirements for locomotives through her own shops, and must obtain large numbers from England and America. Belgium has ordered about four hundred engines in England, and Italy has an order for an equal number in this country. America also controls the Spanish market for locomotives entirely; but previous to the war, Spain had most of her engines built in Germany. Portugal has placed orders for engines in Switzerland, while Poland has made arrangements for ordering 150 locomotives in the United States. The railways of Brazil and Argentina are mainly constructed by British capital, and hence the orders from these roads go mainly to England. Chile, formerly a customer of Germany, has during the war turned to the United States.

Previous to the war the three main locomotive building nations were the United States, England, and Germany. As Germany will be unable to supply her own demand for a long time, let alone competing with other nations, the locomotive building of the world will be in the hands of American and English builders for many years to come.

AN ENGLISH OPINION ON THE METRIC SYSTEM

By H. F. HEMMINGS, Works Manager,
Willans Works of the English Electric Co., Ltd., Rugby, England

In reading the article in the August number of MACHINERY relative to the experience of the De Laval Separator Co., Poughkeepsie, N. Y., the most important point that strikes one is that the De Laval Separator Co. manufactures a specialty under a condition approximating mass production. Many years ago the Willans Works in Rugby were entirely engaged in the manufacture of a specialty—the Willans central valve engine—and at that time adopted the metric system in the engineering and manufacturing departments. The conditions governing the nature of their product have long since changed, and they are now engaged in the manufacture of general engineering products.

As a result, the question as to the advisability of retaining the metric system has had to be considered, and a committee of those responsible for production in this company have given the question of English versus metric measurements as applied to the various works of the English Electric Co., Ltd., full consideration. In considering this matter, the committee had before them at the time a summary of the report of the Committee on Commercial and Industrial Policy after the War, which committee reported against the use of the metric system. The committee of the English Electric Co. issued a report on the use of the metric system at the various works within the combination, which are five in number; after full consideration, the situation was summarized as follows:

1. All public committees whose composition and standing make their reports worthy of consideration have decided against the metric system as a practical proposition for manufacturers in this country.

2. It is not possible to use the metric system in this country to the exclusion of the inch system. Even at Rugby, where a determined effort has been made to make the metric system a commercial success, it has been found quite impossible to eliminate the inch; consequently both systems exist side by side, and a double stock of precision and other tools has to be carried at considerable expense. Our experience at Preston and Stafford is the same.

3. There are therefore two alternatives to choose from, either (a) the inch system by itself; or (b) a dual system consisting of inch and millimeter.

4. The question arises whether each works can settle the question for itself, or whether a uniform system of measurement should be used by all works within the combine. Since the matter is almost entirely one of works production, and in view of the importance of interchangeable manufacture, it would appear a matter of prime importance to use the same system of measurement in all works.

5. While the designer might prefer to retain the millimeter, the shops, without doubt, prefer the inch. The question before the committee, therefore, is: Can we get back to the inch as a unit of measurement, or is it better to retain the present dual system of millimeter and inch?

It was considered that it was not a commercial or practical proposition to work with both systems, and of the two systems the committee was of the opinion that the English was the preferable one, so far as the products of the various works of this company were concerned.

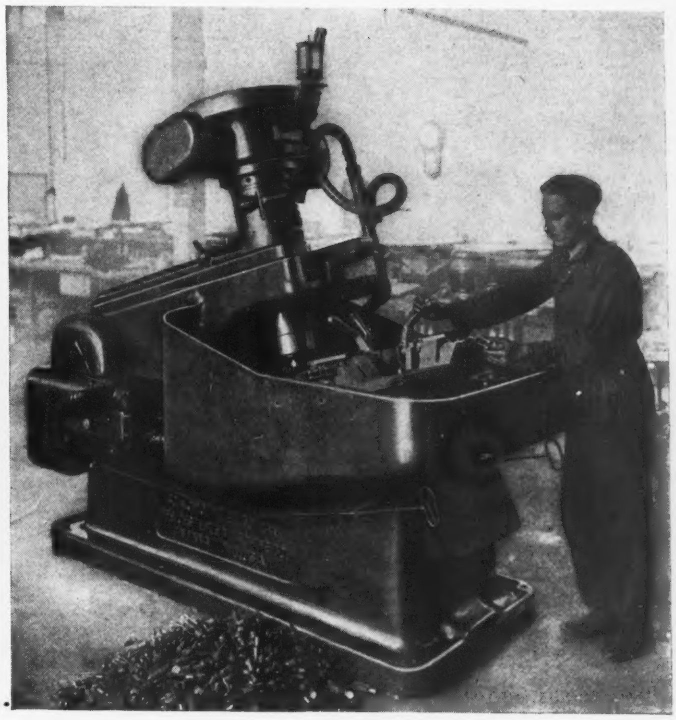
* * *

There are indications from various sources that the Japanese manufacturers who secured a considerable amount of foreign trade during the war are not finding it easy to maintain their hold on the foreign markets. In the machine tool field Japan secured a large share of the trade in China and Siberia, partly by selling machines manufactured in Japan, and partly by re-exporting machinery imported mainly from America. Now both America and England can handle this foreign trade more effectively.

Continuous Versus Station Milling

Comparison of Results that are Obtained by Both Methods of Milling on Identical Work when Using Similar Machines in Interchangeable Manufacture

By GEORGE M. MEYNCKE
Sales Manager and Mechanical Engineer
The Oesterlein Machine Co., Cincinnati, O.



THE fundamental differences between continuous and station milling as conducted on the Ohio tilted rotary milling machines manufactured by the Oesterlein Machine Co., Cincinnati, Ohio, are the method in which the cutters are applied to the work and the manner in which the table is rotated. In the case of continuous milling, the work is spaced compactly around the periphery of the table, and the successive parts are milled as they are fed past the revolving cutters when the table is rotated. In station milling, a number of pieces are grouped at regular intervals around the table and the revolving cutters are first fed toward the center of the table until all parts in the particular station that happens to be in the path of the cutter have been machined, the table being stationary during this step of the operation. The cutters are then returned rapidly to their starting position, after which the table is indexed a portion of a revolution in order to bring the next station into the path traversed by the cutters. The reciprocatory movements of the cutters are obtained by having the vertical cutter-spindle on this machine mounted on a ram which is quite similar to the ram of a shaper. The number of stations on a table depends to some extent upon the time required to unload and load a station, which must be accomplished while the work held in another station is being machined. When a milling machine is set for indexing 180 degrees between the reciprocations of the cutters, one fixture that is provided with a station at each end is frequently employed. It is the purpose of the present article to examine in some detail the conditions that exist when either of the two methods referred to are used and to compare the advantages of each method under different conditions. In doing so, some of the present conceptions as to the relative merits of the two methods are challenged.

Station Milling Permits Higher Rates of Production than Continuous Milling

Both of the milling methods being considered are employed by manufacturers in the present-day attempts to secure maximum rates of production; however, mistaken ideas concerning the relative merits of the two processes are prevalent. It has been the experience of the Oesterlein Machine Co. that much higher rates of production are secured by station milling than when the same work is machined on a similar machine by continuous milling methods. This result is due to the fact that in station milling, the cutters are fed a much less distance than the table must be fed in continuous milling in order to machine a like number of pieces. The return of the cutters to their original position and the indexing of the table in station milling are accomplished at such speeds that the greater portion of the gain over continuous milling methods, secured by the cutters, is maintained. In the following, several examples will be given of cases where both milling methods are used in machining identical parts, for the purpose of permitting comparisons to be made of the results obtained and an opinion to be formed as to the advantages of each method.

Example Showing Advantage of Station Milling Method

The machining of a small part consisting of a shank having a circular boss at one end which is straddle-milled flat on both sides will be considered first. The method of arranging the work on the machine for continuous milling is shown diagrammatically in Fig. 1, there being thirty-eight work-holding units on the fixture attached to the table for holding the work in place. The diameter of the boss on each part is 2 inches, and the distance between the bosses of two adjacent pieces, as mounted on the fixture, is ½ inch. It is apparent that the cutters and table revolve constantly, the operator loading and unloading work at the front of the machine while the cutters mill pieces held diametrically opposite on the fixture. In using this method there is a certain amount of idle time due to the spaces between the parts. Fig. 2 shows the set-up of the work on the machine used in station milling and the direction and distance that the cutters reciprocate. It will be noted that four parts are so grouped that they are milled simultaneously by the cutter, the travel of the cutter in each movement being only slightly more than the diameter of the boss on the work. The idle time in this method consists of the time required for the cutter to return after being fed across the work, which is three seconds, and the four seconds consumed in indexing the table to the next station, this making a total of seven seconds. The rates of production obtained by the two methods will now be compared.

The rate at which the cutters are fed in the station milling method and the rate of table feed in the continuous milling method are both 6 inches per minute. Thus, the time required to feed the cutters across the four pieces held in one station in Fig. 2 is approximately 28 seconds. By adding to this quantity, the 7 seconds of idle time previously mentioned, a total of 35 seconds is obtained which is the time required to finish four parts by this method. By referring

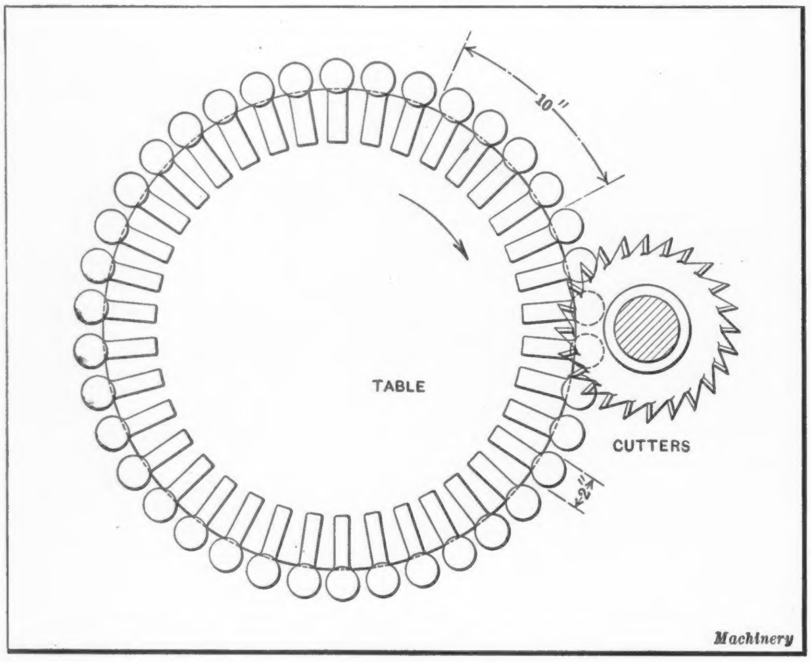


Fig. 1. Diagram illustrating the Relation of the Table and the Work in a Continuous Milling Operation

to Fig. 1 it will be seen that as the diameter of each boss is 2 inches, and the distance between them ½ inch, the table of the machine used in continuous milling must travel 10 inches in order to machine the same number of parts. This requires 1 minute 40 seconds, or 1 minute 5 seconds more than is necessary in machining the same number of parts on the machine adapted for station milling. Thus, the latter method permits a rate of production almost three times that obtained by continuous milling. Besides this great advantage another point in favor of station milling is the fact that the cost of a fixture for this method is considerably less, this being due to the smaller number of work-holding units necessary. It will be noted that in milling the four parts by the continuous method, the idle travel is 2 inches, this being the sum of the spaces between the bosses that the cutters are required to pass.

Milling Automobile Brake Rod Clevises by Both Methods

A machine equipped with a fixture adapting it for the continuous milling of automobile brake rod clevises is shown in Fig. 3. This fixture has forty-eight work-holding units. Three cutters are mounted on the machine spindle for this operation, which consists of straddle-milling the two inside and the two outside surfaces of the jaw on each part. The illustration shows the cutters in the working position. Attention is called to the fact that the ends of the work on which the operation is performed are placed toward the center of the fixture rather than toward the outside as in the case previously cited. The object in doing this is to reduce the space between each part as much as possible and so cause a reduction in the idle travel of the cutters.

A general view of a similar machine provided with a set-up for machining the clevises by station milling, is shown in the heading illustration. Fig. 4 shows a close-up view of the same machine. The fixture on this machine has four stations, each of which contains three work-holding units. The three pieces of work in each station are equalized and clamped by a single movement of the lever connected to that particular station. The operation of this machine is, of course, entirely automatic so that the attention of the operator is fully devoted to the work of loading and unloading the stations as they are indexed from the cutter to the front of the machine. It will be seen by referring to the illustration that the jaws that are to be machined in this instance are placed toward the outside of the milling fixture.

As in the example previously considered, the results obtained in this case by both methods indicate that station milling is the most suitable for work of this nature. The table of the machine equipped for continuous milling is fed at the rate of 10 inches per minute, which results in an output of 350 pieces per hour, representing an average cutting time of 10.3 seconds per piece. The hourly output on the station milling machine by feeding the cutters at the reduced rate of 7.5 inches per minute, is 612 pieces, the average cutting time per piece being about 5.9 seconds. These results show that the rate of production by station milling is 177 per cent of the production obtained by continuous milling. The cutters on both machines are operated at a speed of 60 feet per minute.

Other Advantages of Station over Continuous Milling

The reason for making the feed of the cutters on the station milling machine less than the feed of the table on the continuous milling machine is to reduce the production so as to enable one man to perform the loading and unloading of the work in a station in the time required for the parts in another station to be milled. It is apparent that if the feed of the cutters in station milling was the same as that of the table in continuous milling, the results would be still more in favor of station milling. The reduced rate of feed results in a higher grade of finish being obtained on the parts milled by station milling, and the life of the cutters is also longer. The practice is to change the cutters on both machines daily, and the wear of the cutters used in continuous milling is usually the greater. While the high output obtained by station milling makes this method desirable for quantity production, perhaps the greatest advantage of this method of milling over the continuous method is the possibility of securing a higher quality of finish in the manner previously described.

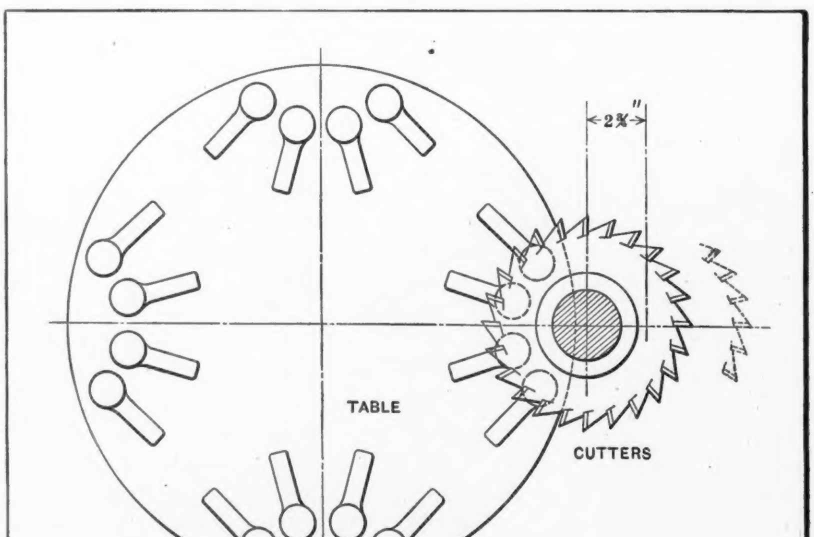


Fig. 2. Set-up of Work on Table, and Feeding Movement of Cutters in Station Milling on an Ohio Tilted Rotary Milling Machine

Another important advantage that station milling has over continuous milling is that, on account of the cutters being fed radially into the work, it is possible to mill circular surfaces having radii corresponding to those of the cutters. This is, of course, impossible in continuous milling, because in this case the surfaces are always milled to a radius equal to the distance from the surface being machined to the center of the revolving table. By designing the fixture on the station milling machine to suit, a number of parts can be mounted on top of each other in such a manner that surfaces of the type mentioned can be finished on each part by straddle-milling. In conclusion, it may be said that while continuous milling may be applied efficiently only to parts that can be placed compactly around the periphery of the table, this does not hold true for station milling. In the latter method, a small surface on a comparatively large piece can be milled with little idle time due to the method of feeding the cutter and indexing the table as has been explained in detail in the foregoing.

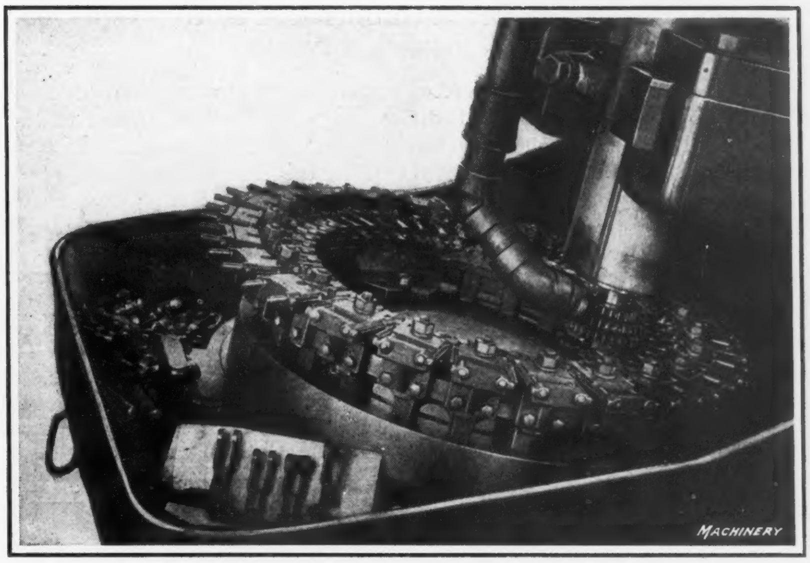


Fig. 3. Continuous Milling Fixture for holding Forty-eight Brake Rod Clevises, and Method of applying Cutters to Work

* * *

NEED FOR USING COAL ECONOMICALLY

If the present rate of steel exports is maintained the total exports for the year will be 4,600,000 gross tons. In the production of this steel, 20,000,000 net tons of coal are consumed. It has been proposed that the exports of coal to foreign countries should be stopped, or at least greatly curtailed, because of the shortage of coal in this country. It has been pointed out that the exports of steel really represent exports of coal; but surely no one would want to interfere with the normal trade channels in regard to the products of the industries of the United States, even with a view to saving coal. It is doubtful if it would be any wiser to interfere with the normal trade channels in regard to coal itself. If the boiler plants in the United States were operated with greater efficiency than they are, the amount of coal exported could easily be saved several times over without curtailing either the production of power or the use of coal for any other purposes than those for which it is now used. In this connection it may be of interest to mention that in the making of paper, the mills in the United States use more than twice the amount of coal per pound of paper that is used in some of the European paper mills.

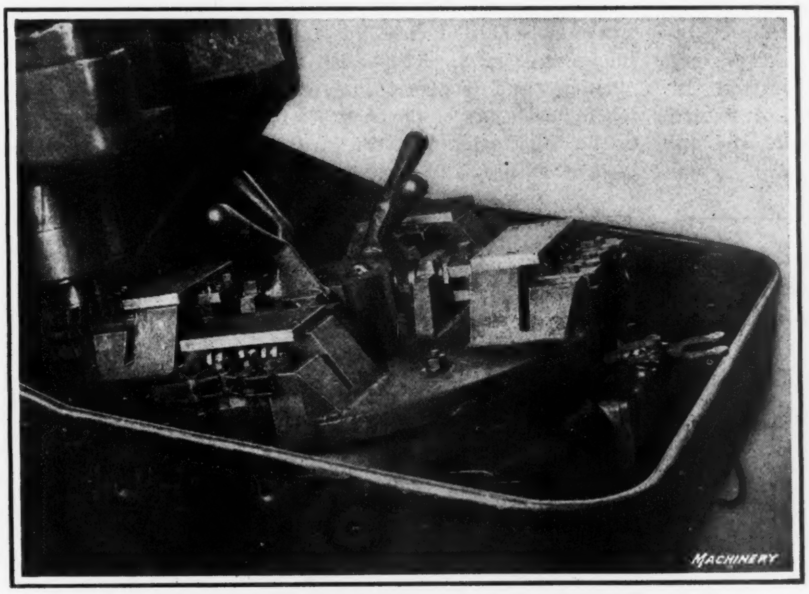


Fig. 4. Machine equipped with Four-station Fixture for holding Clevises when station-milling them

IMPROVED RAILWAY FREIGHT SERVICE

The Association of Railway Executives, in its effort to improve the freight situation of the country, is urging the cooperation of manufacturers to attain, as a definite aim, an average minimum movement of freight cars of not less than thirty miles per day, and an average loading of thirty tons per car. In addition, the association will work for a reduction of the bad-order cars to a maximum of 4 per cent of the total number of cars in use, and an early and substantial reduction in the number of locomotives now unfit for service. It has been pointed out that an increase in the average freight car movement of only one mile a day is equivalent to the enlarging of the available supply of freight cars by 100,000.

Manufacturers using freight cars can aid a great deal in making it possible for the railway executives to adhere to the program laid out. According to reliable calculations, it has been determined that the average freight car is in a train moving between one terminal and another actually only 2.6 hours out of 24; but it is in the service of the shipper or receiver 8 hours out of every 24. The average freight car movement in 1916 was 26.9 miles per day. If this is increased to 30 miles per day, it is equivalent to the building of 300,000 freight cars. By intelligent operation of the railways and real cooperation on the part of every individual shipper, this can be done. Under the stress of war in May, 1917, an average movement of 29 miles per car per day was reached, and there is no reason why this average, or slightly greater, cannot be attained in times of peace.

Summing up the matter briefly, it is important that shippers should load cars as quickly as possible after they are received, and the shipper should then furnish prompt and definite billing instructions, which should take the car, if possible, to its ultimate destination. Special billing causes delay, and the practice of billing cars subject to order or reconsignment in transit prevents good freight service. It retards the movements of cars, and should be discouraged, because it is injurious to the whole transportation system, and when practiced by a few, amounts to a special privilege which, owing to the delay in transportation, causes an added expense and inconvenience to other shippers.

As to the loading of cars, one additional ton per each loaded car would be equal to 80,000 new freight cars.

DRAFTING-ROOM PROGRESS RECORDS

By ALBERT A. DOWD

In a drafting-room containing fifty or more men, so many drawings are being made that it is difficult to carry the work through without an adequate system for keeping track of the various jobs. This is especially true in the case of a concern preparing drawings for an outside customer. It is not particularly hard to get a drawing completed, but to have it approved, checked, and delivered when desired is another matter. Drawings for jigs and fixtures are often wanted in a hurry, and yet when a great number of them are in process at the same time, the drawings for several fixtures for some particular part may be held up for various reasons so that they are not completed at the same time as the drawings for the remainder of the tools. This is often the cause of a considerable delay in the ultimate production of the tools.

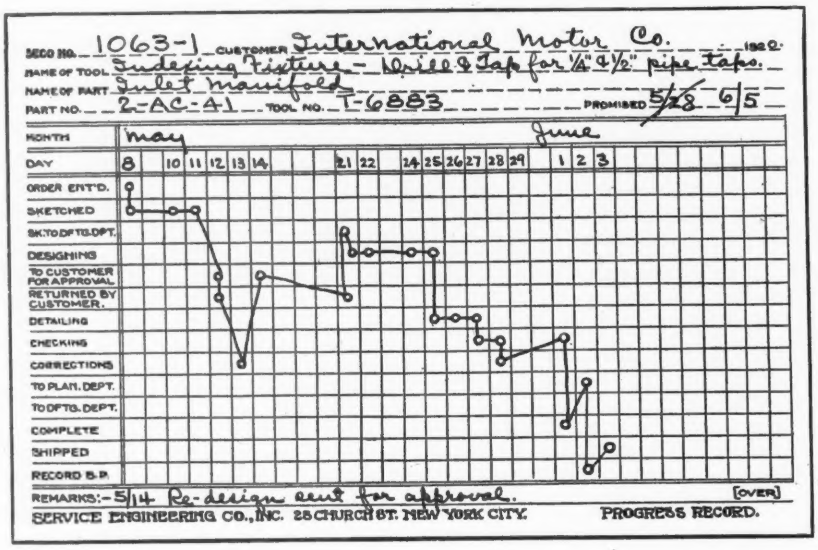


Fig. 1. Progress Card which shows graphically the Progress of a Job through the Drafting-room

A method commonly used to follow drawings of this kind is to check off the various tools on the operation sheet of the part as fast as the drawings are completed. It frequently happens, however, that these drawings go to a tool checker who has a number of other drawings waiting to be checked, and are greatly delayed there on account of other work being checked first. In our organization, work is frequently in progress for a dozen or more firms at the same time, and it was found absolutely necessary to devise a system whereby it would be certain that a drawing would be completed at approximately the right time.

It is obvious that a system of this kind must be self-checking and simple enough to be taken care of by a man who is not necessarily connected with the drafting-room itself. It must also be remembered that various customers have different ideas in regard to the handling of their work. For example, one customer may wish to see a rough sketch of the proposed jig or fixture before authorizing the completion of the tool. Another customer may leave the matter of design to the judgment of the firm making the drawings, and may not require that the drawings be sent for approval. In the first case, the record of progress of any jig or fixture drawings must show that the sketches were made and approved before any designing takes place. Hence, it is apparent that the record card must be so arranged as to take care of these varying conditions, and when completed must form a record of the progress of the work from start to finish. The system that was installed for the purposes outlined is described in the following.

Description of Graphic Progress Cards

Fig. 1 shows a progress card filled out to show the record of the drawings for an indexing fixture for an automobile inlet manifold. The card shows that the order was received on May 8, and that a rough sketch was completed on the 11th, and sent to the customer for approval on the 12th. On the same day the sketch was returned by the customer with suggested changes, which were made on the 13th, and the rough sketch was once more sent for approval on the 14th. After a delay of a week, it was returned by the customer approved, and was then sent to the drafting department with an order to proceed with the work. The record shows that the designing was completed on May 25, and that the detailing started on the same date. The detailing was completed on the 27th, and the checker received the drawings on the same day, completing the checking on the 28th. After the corrections had been made, the drawings were returned to the checker for final inspection on June 1. They were later blueprinted and finally shipped to the customer on the 3rd.

It will be noted that the promised date on this card was originally May 28, but, due to the delay of a week in approving the sketch, this date was changed to June 5. However, the work was completed on June 3, which was two days in advance of the promised date. This card record is made out directly from the time cards which the men turn in each day.

Follow-up Card

In connection with the progress card, a simple follow-up system has been devised in which use is made of the card shown in Fig. 2. This card is intended to be used as a "tickler," and is placed in a card file which has an index tab for each day of the month. It will be seen by referring to the illustration that the card contains the order number, type of fixture, and the promised date of delivery.

1063-1 Indexing Fixture Promised ~~May 28th~~

Extended to June 5th.

Note: This job was sent twice for approval (May 12th. & May 14th.) and held one week by customer.

May 28th. Waiting for final checking.

Shipped complete to customer - June 3rd.

Fig. 2. "Tickler" Card used to follow up the Progress of a Job

SECO No. 1063-1 OPER. No. 4 TOOL No. T-6883

International Motor Co. Part No. 2 AC 41

R'C'D FROM P. D.	ASSEMBLY SENT TO P. D.	DRAWING APPROVED	DESIGN CORRECT	DATE PROMISED	DRAWING COMPLETED	R'C'D B/P
5/21	—	✓	✓	~~5/28~~ 6/5	6/1	6/2

NAME OF TOOL Indexing Fixture for Drilling & Tapping.

REMARKS Part Name: Inlet Manifold

DESIGN	Ginsberg	5/21 1 PM	5/25 4 PM	
DETAIL	Ondrick	5/25 4 PM	5/27 4 PM	
CHECK	Lipkin	5/27 5 PM	5/28 4:30 PM	6/1
CORRECT	Ondrick	5/28 1:30	5/28 3:30	

Fig. 3. Card for recording Time spent by Men on a Job

In use, this card is placed in the "tickler" file under a date about a week in advance of the time when the work is promised. By referring to this file each day, and by transferring the card from one position in the file to another, it is evident that a constant check can be kept on the work as it progresses. When used in this way, there is a constant reminder of any job that is to be completed at a certain time and there is no chance for the work to be sidetracked, provided the system is followed up carefully as intended. Notes containing information concerning the job can be placed on the card as shown.

Draftsman's Record Card

In connection with the "tickler" file, use is made of another card, which is shown in Fig. 3. The purpose of this card is apparent, and it will be noted that the designer, detailer, and checker are all considered. A record is kept of the date and hour that each man began to work on the job and when he completed it. Thus, in connection with the other cards, a complete record of any particular job is kept. In all probability, this system can be simplified for use in ordinary drafting-rooms, but under the conditions mentioned, the system as outlined has worked excellently.

* * *

WHAT IS A MACHINE TOOL?

A definition of the term "machine tool" that will satisfy all requirements has yet to be proposed. L. L. Thwing, of Boston, Mass., in an interesting article in the August number of *Mechanical Engineering*—the journal of the American Society of Mechanical Engineers—goes into the history of the various proposed definitions of machine tools and the uses of the term. He mentions that at a meeting of the American Society of Mechanical Engineers in 1885 one of the subjects for discussion was the power requirements for machine tools. In the course of this discussion one of the speakers, complaining about the indefiniteness of the question, said, "What a machine tool is, is slightly in doubt," and this question has been with us ever since. The dictionaries define it as a machine that uses tools, and the Custom House officials have accepted this and include woodworking machines under this classification. Users, dealers, and manufacturers, however, do not accept the definition, and the whole subject is as far from being settled as it was in 1885.

Early Uses of the Term "Machine Tools"

Edward H. Knight in his mechanical dictionary, published in 1872, gives the following definitions: "*Machine*: An instrument of lower grade than an engine, its motor being separate. It is distinct from a tool, as it contains within itself its own guide for operation. *Machine Tool*: A machine in which the tool is directed by guides and automatic appliances. Among tools of this class for metals are lathes, punches, and shears. Machine tools for wood are sawing machines, planing machines, etc."

It is the habit of dictionary makers to copy each other, and it is not improbable that our present-day dictionary interpretation of the word is derived from the above. It must also be said that to define a machine tool as a tool-using machine is very natural. There is some doubt, however, if the original and common use of the words is as indicated above.

Cameron Knight, author of "The Mechanician and Constructor," published in 1869, in the course of a very complete definition of shop terms, includes the following: "Tools include every implement small and large, simple or complex, which is used to produce or operate upon the work in the course of progress. A center-punch in a turner's pocket is a tool, and the lathe before him is a tool."

It is an easily verified fact that in the text and advertising columns of the early mechanical papers such as the *Scientific American* (1846), the *Mechanics' Magazine* (1836), and the *American Artizan* (1862), the term "machine tools" is used but seldom, and then exclusively by editorial writers. The first observed use was in 1862. "Tools" is the word that was in universal use during the Civil War period to indicate what we now call machine tools. Advertisements for the sale of the after-war surplus were either under this caption or under the heading "machinist's tools." This use of the word persists into the eighties. In fact, in the discussion referred to in the opening paragraph, the word "tools" was not infrequently used. There can be no reasonable doubt, therefore, that although the expression "machine tools" was at least recognized as far back as 1860, "tools" was the word in common and everyday use until the eighties. In 1879, Frederic B. Miles formed a company with the name "Machine Tool Works." This is the first noted instance of the use of this term by a shop man. The above company advertised the manufacture of steam hammers, planing machines, and lathes.

Suggested Definitions of Machine Tool

On first thought we may be inclined to define a machinist as a machine-using workman, and a machine shop as a machine-using shop, but this definition will admit weavers and textile mills to these classifications. It is evident that a machinist is a machine-*building* workman, and a machine shop is a shop that *builds* machinery. By an analogous reasoning a machine tool is not a tool-using machine, but a machine-building tool; that is, a tool or machine for building machinery. This definition conforms to the best modern definition of the term, namely, "Machine tools are machines which, when taken as a group, will reproduce themselves." This excellent definition has the disadvantage of being general rather than specific, and as a secondary definition the following might be suggested: "A machine tool is any metal-working tool the waste from which is in the form of chips." This is specific and can be easily applied to any particular machine. It is not necessary to define a metal "chip," but it may be advisable to recall that the sparks from a grinding machine are chips, very small chips to be sure, but chips. This definition excludes sheet-metal working machinery and metal-forming and forging machines, but these are probably not classed as machine tools by the majority of shop men, and in any case it is necessary to draw the line somewhere, and this seems to be the best place. This classification includes all metal-cutting machinery the action of which is a progressive cutting away of surplus stock—a gradual reduction in size until the finished dimensions are reached.

A press, when used for piercing sheet metal, has very little in common with a lathe, a milling machine or a planer. They are all metal-cutting machines, and here the similarity ceases. The metal is not in the same form, and the cutting tools have nothing in common with other metal-cutting tools as to construction or cutting angles. When a press is used for forming it has nothing in common with lathes, etc., other than the fact that they are all metal-*working* machines, as are also power hammers, bulldozers, swaging machines, etc.

* * *

THERMOSTATIC METAL

An interesting metal known as "thermostatic" metal is manufactured by the British Thomson-Houston Co., Ltd. This metal, which is homogeneous in appearance, is formed, according to *Engineering*, of two metal strips having widely different coefficients of expansion. The two metals are welded together along their entire length and are quite inseparable under normal working conditions. When the duplex strip is subjected to change of temperature, one half will expand more quickly than the other, causing the strip to bend. A single degree of temperature change is said to affect its curvature to a measurable extent, and practically instantaneously. In bending, it exerts a force sufficient for the direct operation of levers, the opening and closing of ventilators, etc. The metal can be cut, stamped or machined. It is supplied in various thicknesses from 0.015 to 0.250 inch.

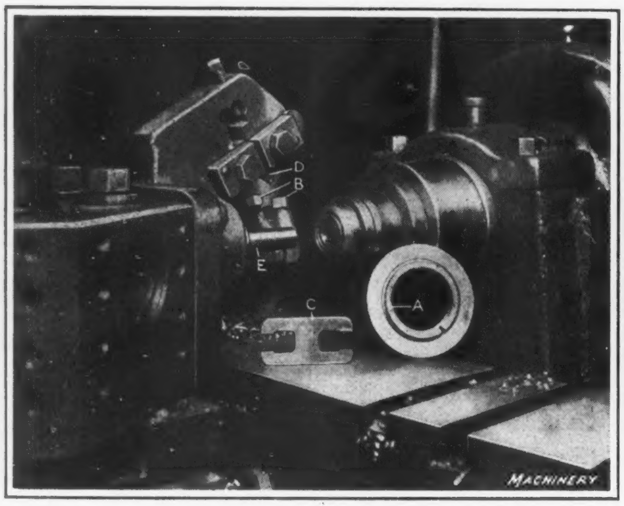


Fig. 1. Bardons & Oliver No. 4 Turret Lathe equipped for turning and facing Clutch Flange Nuts of the Type shown in Fig. 3

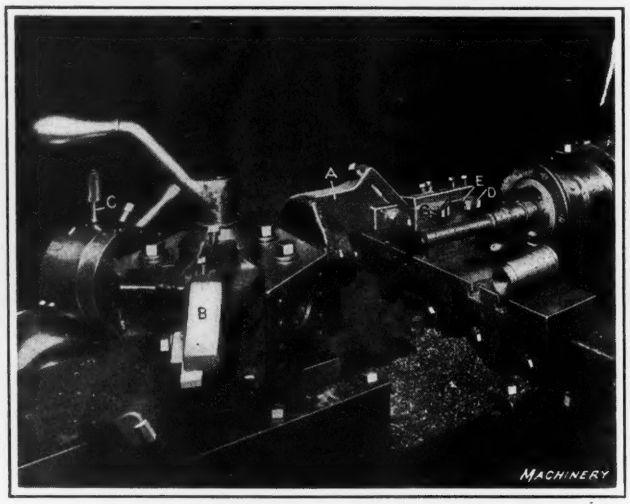


Fig. 2. Close View of the Chuck and Tools on a Bardons & Oliver Turret Lathe used for machining Sleeve shown in Fig. 5

Machining Clutch Parts on Turret Lathes

Tooling Equipment Used in the Plant of the Borg & Beck Co., Chicago, Ill., for Machining Automobile Clutches

AT the Borg & Beck Co.'s plant in Chicago, Ill., the work consists of producing clutches for motor cars, and in the manufacture of this specialized product there are some interesting applications of turret lathes built by the Bardons & Oliver Co. of Cleveland, Ohio. Most of the clutch parts to be machined are of small or medium size, and in handling this work advantageous use is made of automatic screw machines on which the preliminary operations are performed; but in cases where machines of this type are used in combination with turret lathes, the work to be handled is of such a character that the automatic could not complete the machining operations that are required, and Bardons & Oliver machines are used for the performance of a second series of operations. A typical case of this kind is illustrated in Figs. 1, 3, and 4 which show the flange nut for a Borg & Beck clutch (Fig. 3), a No. 4 Bardons & Oliver turret lathe set up for the second sequence of operations on this part (Fig. 1), and the threaded mandrel used for holding the work on the turret lathe (Fig. 4). In Fig. 1 one of the pieces to be machined is shown at *A* and referring to the detail view of this piece, Fig. 3, attention is called to the fact that the automatic is utilized for boring and tapping hole *A* and for finishing surfaces *B*, *C*, and *D*.

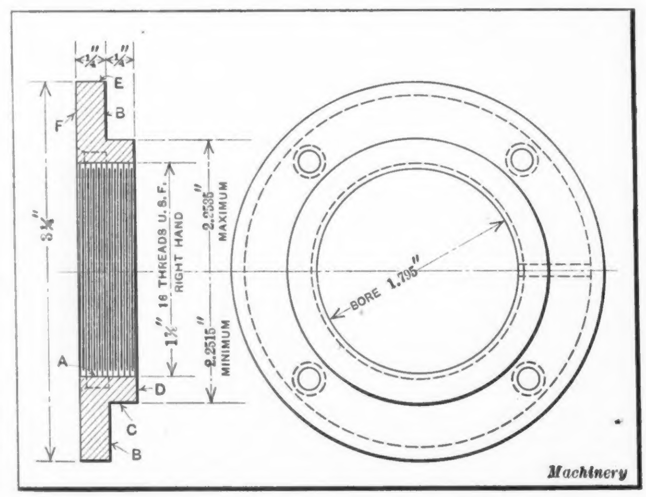


Fig. 3. Clutch Flange Nut on which Turning and Facing Operations are performed on Bardons & Oliver No. 4 Turret Lathes

For the second sequence of operations the tapped hole *A* and face *D* are utilized as the locating points; and in Fig. 4 it will be seen that thread *A* on the mandrel is made of such a diameter that the flange nut to be machined can be readily spun into position by giving it a sharp turn with the finger and thumb, which brings face *D*, Fig. 3, back against sliding collar *B*, Fig. 4, on the mandrel. After this result has been accomplished the draw-back mechanism of the turret lathe is used to pull back the shank of the mandrel so that the work is held firmly against collar *B*, the mandrel sliding through the housing and causing the collar *B* to act like a lock-nut to secure the work in place. In Fig. 3, the surfaces to be machined on the Bardons & Oliver turret lathe are the

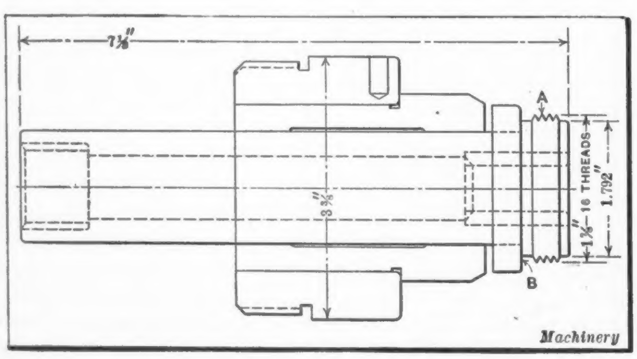


Fig. 4. Special Threaded Mandrel connected with Spindle Draw-in Mechanism for holding Clutch Flange Nuts of the Type shown in Fig. 3

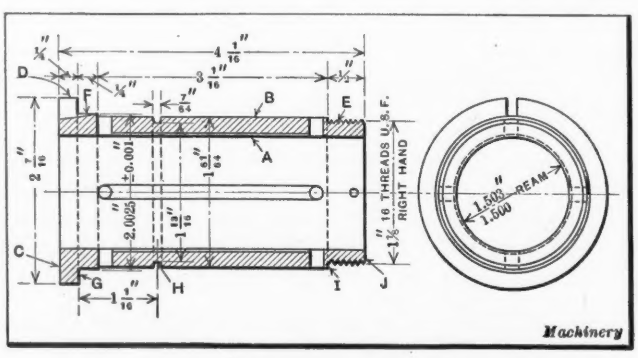


Fig. 5. Clutch Throw-out Sleeve on which Turning, Facing, and Threading Operations are performed on a Bardons & Oliver No. 4 turret lathe

outside diameter *E* and faces *F* and *B*. It is important for faces *F* and *B* to be so finished that the thickness of the flange is exactly ¼ inch.

It will be recalled that surface *B* is rough-turned on the automatic screw machine, but in order to get the required thickness for the work, there are two straddle facing tools held by set-screws shown at *B* in Fig. 1, which are mounted at the front of the cross-slide, one of the tools being set slightly in advance of the other so that this tool feeds right across surface *F*, Fig. 3, while the second tool only feeds down surface *B* until it reaches shoulder *C*. At *C* in Fig. 1 there is shown a "Go" and "Not Go" gage used to test the accuracy of the flange thickness. Turret tool *D* turns the outside diameter of the work, and it will be seen that there is a pilot *E* which enters the hardened steel bushing in the front end of the mandrel to maintain accurate alignment. After the operation has been completed, the draw-back mechanism is released in order to relieve the frictional resistance of the back side of the work against the collar *B* on the threaded mandrel. It is then an easy matter for the operator to screw the work off the mandrel by hand. The flange nuts to be machined by this means are made of malleable iron, and the job is performed at a cutting speed of 80 feet per minute with a feed of 0.020 inch per revolution. The rate of production is 800 to 1000 pieces in a ten-hour day.

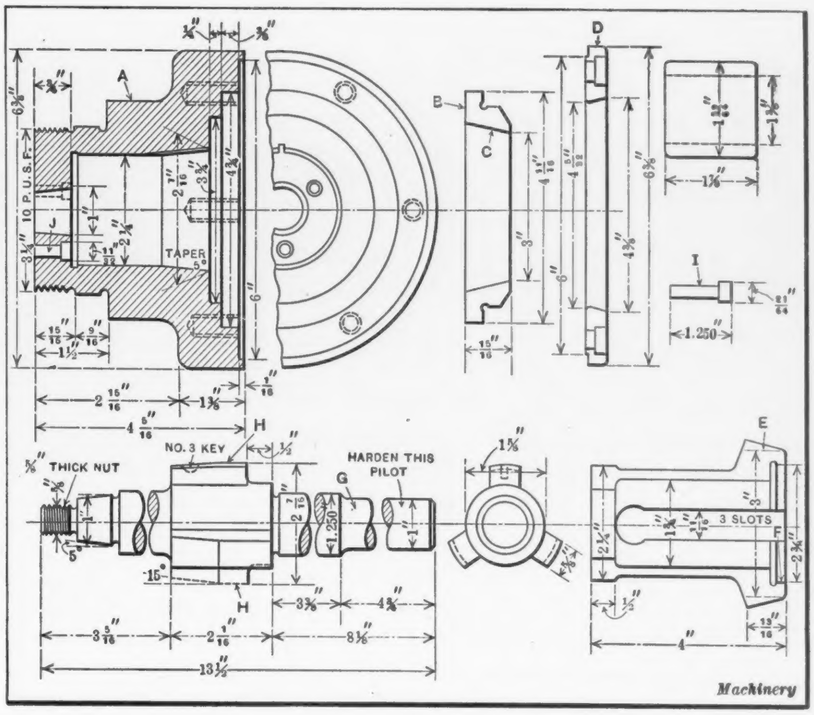


Fig. 6. Parts of the Special Collet Chuck that is used on the Machine shown in Fig. 2 for holding Throw-out Sleeve shown in Fig. 5

Machining Malleable-iron Throw-out Sleeves

In Fig. 5 is shown a malleable-iron throw-out sleeve for a Borg & Beck clutch, which has previously had hole *A* bored and reamed, diameter *B* turned, end *C* faced, and flange *D* turned, so that in some respects the work to be done by the No. 4 Bardons & Oliver machine shown in Fig. 2, that is utilized for the performance of a second sequence of operations, is rather similar to the job which has just been discussed. The machine on which this work is done is equipped with a collet chuck of the type shown in Fig. 6, which grips the work by the outside of flange *D*, Fig. 5. Referring to Fig. 6, attention is called to the fact that chuck body *A* is secured to the draw-back mechanism and has a collar *B* with a tapered bore *C*, this collar being held in place by a ring *D* so that it is a floating fit. Split collet *E* is counterbored at *F* to receive the flange of the work, and extending through the center of this collet there is a pilot *G* that enters bushings in successive faces of the turret to assure accurate alignment. The larger of the two diameters of this pilot fits in the bore of the work and supports the overhanging portion which would otherwise produce too great a strain for the collet to hold securely. It will be seen that the body of the pilot is keyed in the chuck, and the splines *H* enter the spaces between the collet jaws, thus locking the collet to the body of the chuck. As chuck body *A* is moved by the draw-back mechanism, ring *D* draws tapered bore *C* of collar *B* back over the tapered nose of collet *E* and closes this collet in to grip the work. Plunger-pins *I* fit in holes *J* at the back of the chuck body *A* and hold collet *E* against lateral movement, thus causing it to grip the work.

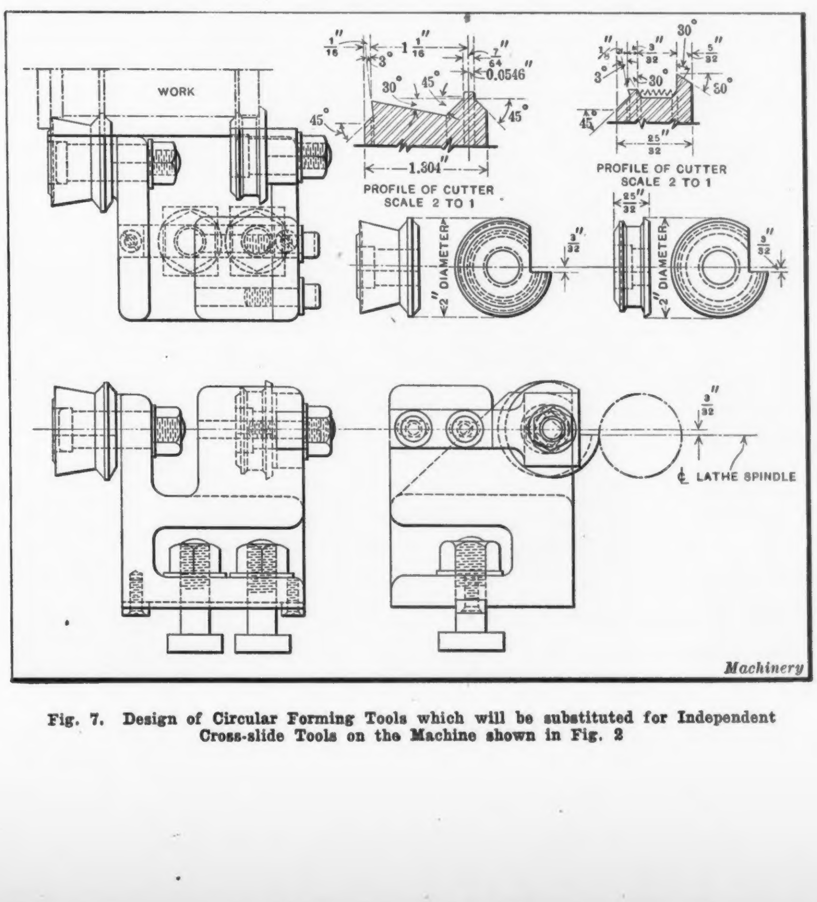


Fig. 7. Design of Circular Forming Tools which will be substituted for Independent Cross-slide Tools on the Machine shown in Fig. 2

Mounted on the first station of the turret there is a turning tool *A*, Fig. 2, having three cutter bits which are so located that they provide for taking an intermediate cut on diameter *B* Fig. 5, and for rough-turning diameters *E* and *F*. At the second station there is a turning tool *B* that provides for taking a finish cut over outside diameter *B* on the work, and at the third station there is a Geometric threading die *C* which cuts thread *E* on the work. Mounted on the front of the cross-slide it will be seen that there are four tools *D*, *E*, *F*, and *G*, which are used, respectively, for facing surface *G*, necking the work at *H*, facing shoulder *I*, and cutting off and chamfering end *J*. At the present time the tool-room of the Borg & Beck Co. is making two circular forming tools which will provide for performing operations on the work at *CH* and at *IJ*, and it is expected that better results will be obtained in this way than those secured with the four separate tools on the cross-slide. Fig. 7 shows the two circular forming tools that have been designed for this purpose. The same rates of speed and feed are employed as for the malleable-iron flange nut

shown in Fig. 3, and the rate of production obtained on these throw-out sleeves is 320 pieces in a ten-hour day.

Machining Bronze Throw-out Sleeves

Fig. 8 illustrates a bronze throw-out sleeve for a Borg & Beck clutch on which the method of machining is similar to that employed for making malleable-iron sleeves of the form shown in Fig. 5. There are, however, certain interesting modifications in the method of tooling which will doubtless prove of interest. A No. 4 Bardons & Oliver turret lathe equipped for performing the second sequence of operations on this piece is illustrated in Fig. 9 and when the work comes to this machine, hole *A*, Fig. 8, has been bored, recess *B* cut, surface *C* faced, and flange *D* turned. For the second sequence of operations, the work is held in a collet chuck of similar design to the one which was described in connection with the illustration shown in Fig. 6. Referring to Fig. 9, the sleeve to be machined is shown at *A*. On the turret there is a tool *B* with two cutters which provide for turning the thread diameter *E* and the outside diameter *F*, and on the second station of the turret there is a Geometric die *C* that cuts thread *E* on the work. Carried on the front slide it will be seen that there is a tool bit *D* and a double circular forming tool *E*. Tool *D* faces shoulder *G* on the work, and the circular forming tool necks the work at *H* and cuts off and chamfers at *I*. The rate of production obtained in the performance of this operation is 500 sleeves in a ten-hour working day.

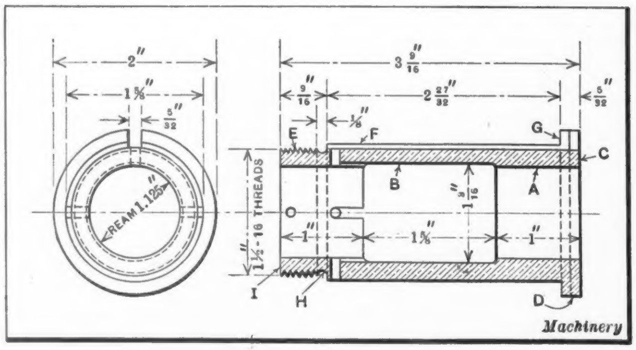


Fig. 8. Clutch Throw-out Sleeve made of Bronze, which is machined on the Bardons & Oliver Turret Lathe shown in Fig. 9

Design of Special Recessing Tool

It will be recalled that on the first sequence of operations performed on the bronze sleeve shown in Fig. 8, it was necessary to cut a recess *B*, and Fig. 12 illustrates quite an interesting type of tool that was designed for this purpose. It is used on the turret of a No. 4 Bardons & Oliver lathe, on which the first sequence of operations is performed, and as the turret tool is fed up to the work sleeve *A* enters the bore, allowing a ball bearing thrust collar *B* to abut against the end of the piece to be machined. With an arrangement of this kind the work is able to continue rotating while in engagement with the fixed tool, without setting up undue frictional resistance. A continuation of the feed movement of the turret slide results in thrust collars *B* and *C* sliding back over sleeve *A*, this movement being accomplished against the resistance of compression spring *E*.

Eccentrically mounted in sleeve *A* there is a tool-bar *F* by which the recessing tool bit *G* is carried; and mounted in thrust collar *C* there is a pin *H* that projects through a slot in sleeve *A* so that its point may enter a cam groove *I* that is cut in the side of tool-bar *F*. Mention has been made of the fact that this tool-bar is eccentrically mounted in sleeve *A*, and it is free to rotate according to the motion imparted through the influence of pin *H* and cam groove *I*, although longitudinal motion is prevented by a pin *J*, that enters an annular groove *K* cut in the rear end of the bar. As the thrust collars *B* and *C* are moved to the left through the forward feeding of the turret slide, pin *H* slides in groove *I* in the cutter-bar, imparting a slight rotary movement to this bar; and owing to the eccentric mounting of the bar *F* in sleeve *A* this rotary movement swings the tool out sufficiently to cut the required recess inside of the work.

Reference to the cross-sectional illustration of the sleeve to be machined, Fig. 8, will show that the recess only extends for a distance of $1\frac{5}{8}$ inches at the center, and that the tool must be advanced 1 inch into the work before starting the recessing operation. This result is accomplished by the form of cam groove *I* which, it will be seen, has a straight section preceding the rise, that causes the tool to move outward radially to cut the recess; then there is a second straight section along which pin *H* slides in order to feed the tool for the required distance to cut a recess of a specified length. The machine stop governs the length of recess that is cut, after which the tool reverses its preceding sequence of operations to return to the starting point. It will be evident from a comparison of Figs. 8 and 12 that the straight portion of the cam groove which precedes the rise is not long enough to allow the tool to be advanced a distance of 1 inch into the work before starting to cut the recess. But as the recessing tool bit has already been entered some distance into the bore of the work before the end of the sleeve engages thrust collar *B*, it will be evident that the form of this cam has been properly developed to give the desired results.

Facing Retractor Collars

Fig. 11 illustrates a malleable-iron retractor collar for a Borg & Beck clutch, and in Fig. 10 there is shown a No. 4 Bardons & Oliver turret lathe set up for facing surface *A* with a single tool mounted on the front slide. Pocket *B* has already been bored and faced, and it is used as the locating point for the second operation. There is really nothing about this job to warrant discussion except the very simple means which has been devised for loading and unloading the work-holding fixture. Referring to Fig. 10, two of the

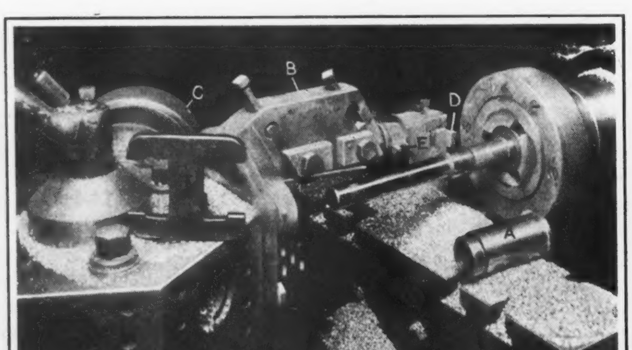


Fig. 9. Cutting Tools and Chuck used on Bardons & Oliver Turret Lathe for machining Bronze Sleeve shown in Fig. 8

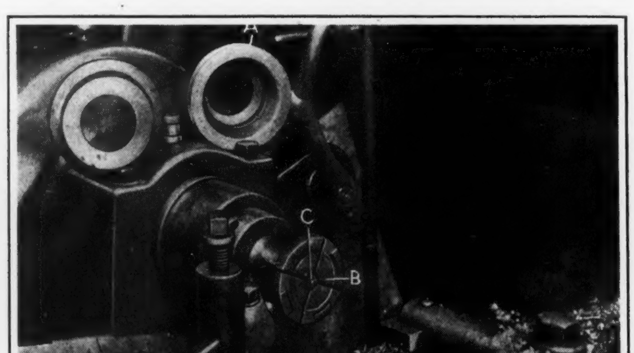


Fig. 10. Close View of the Facing Tool and Expanding Chuck used for holding Retractor Collar shown in Fig. 11

retractor collars are shown at *A*, illustrating opposite sides of the work. At *B* there is illustrated the expanding mandrel on which the work is held. This consists of a simple split mandrel with a flanged end of the proper size to enter pocket *B* in the work. This mandrel is attached to the draw-back mechanism of the turret lathe spindle, and projecting through the inside of it there is a tapered pin *C* that is held against longitudinal movement. By drawing the split mandrel back over this tapered pin, provision is made for expanding the mandrel to provide for gripping the work. Of course, the operation of facing surface *A* on the work is a very simple one, but were it not for the rapidity with which the work can be set up and removed from the mandrel it would be impossible to attain anything like the output of 800 collars in a ten-hour working day that is attained on this job. The work is done at a cutting speed of 80 feet per minute with a feed of 0.020 inch per revolution.

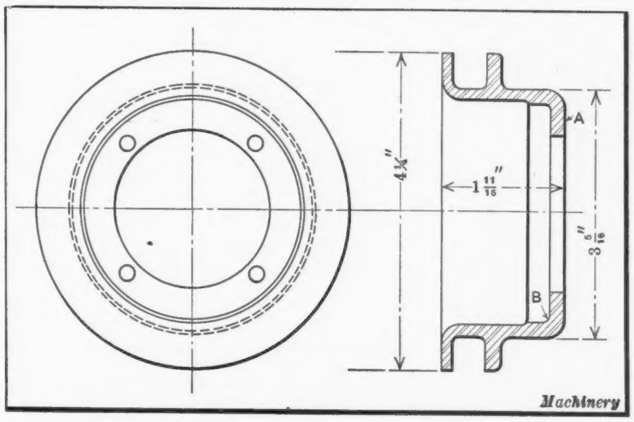


Fig. 11. Retractor Collar which has Surface A faced by a Bardons & Oliver Turret Lathe

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SUBSTITUTES FOR BRONZES

The shortage of many metals in Germany during the war period forced German manufacturers to adopt various substitutes. These are discussed in an article in a recent issue of *Stahl und Eisen;* the results of these German experiments may prove of interest and value in the metal trades everywhere. The following data on the subject have been obtained from a translation made by the *Journal of the American Society of Mechanical Engineers.*

Substitutes in Engine and Pump Manufacture

Crankshaft housings for submarine engines have to be built of a special bronze having very high mechanical qualities, such as high tensile strength and high percentage of elongation. Since the beginning of 1915, due to the shortage of metals, these crankshaft housings were made of cast steel, which did not lead to any particular difficulties and, indeed, with the construction of larger sizes of submarine engines, proved to be an advantage, as it gave to the housing a greater rigidity. On the other hand, the machinability of the material was not as good as that of bronze.

All the screws, bushings, etc., which before the war were made of bronze or copper castings, had to be of iron and tin-coated in order to protect them against rust. This was done by the Schoop process. On the other hand, parts which used to be made of aluminum castings were during the war made of thin sheet iron and then galvanized.

Considerable trouble was experienced with piping. The former copper piping was replaced by steel piping, galvanized inside and out. The zinc coating did not prove satisfactory, however, as it was rapidly eaten away by sea water and salty sea air. The pipes then were protected by lead, which, however, did not adhere well to the steel and chipped off easily under mechanical influences. It, therefore, proved necessary to protect the piping by two coats of metal—zinc first and lead afterward. This required great skill in manufacture and a close control of the temperatures at which the metals were applied, and was therefore not wholly successful.

Conservation of Tin

Vigorous efforts were made to conserve tin. Bronze bushings or parts under heavy stress (such as steering gears) used to be made of a bronze with a 15.5 per cent tin content. During the war these bronze bushings were made of an alloy containing about one-third less tin and were not cast in sand, but in a metal mold so as to give them a greater hardness. This was based on investigations made in 1910 by Heyn and Bauer, which indicated that the hardness of a copper-tin alloy is really a matter that may be controlled either by variation in tin content or by the proper control of temperature conditions during cooling, and, in particular, by the velocity of cooling. It should clearly be borne in mind that this hardening by rapid cooling is possible only with bronzes and not with brasses.

Bronze bushings with a tin content of 10 per cent were machined and after having been set in their seats were hardened on their surfaces by having a mandrel driven in under high hydraulic pressure. Parts not subject to heavy stresses were made of zinc castings, and it appears that the strength of such parts was materially affected by the heat-treatment to which they were subjected.

An effort was made to produce a bearing metal containing 42 per cent tin, 42 per cent lead, 2 per cent copper and 14 per cent antimony, but it has not as yet been carried to a successful conclusion.

Metals for Steam and Water Nozzles

Considerable trouble was experienced in attempts to find substitute metals for use in nozzles through which water, steam, gases or acids are discharged under pressure. Here, in addition to other conditions, the tendency to corrosion and erosion had to be met. In particular, in injectors, attempts were made to substitute cast-iron nozzles for bronze, but it was found that the former did not stand up well when used either with steam or hot water. The inner wall of the nozzle was strongly corroded, which interfered with the efficiency of the apparatus.

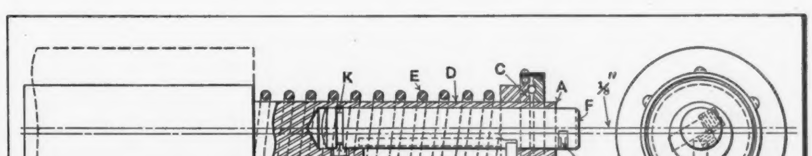


Fig. 12. Tool for cutting Recess in the Bore of Sleeve shown in Fig. 8

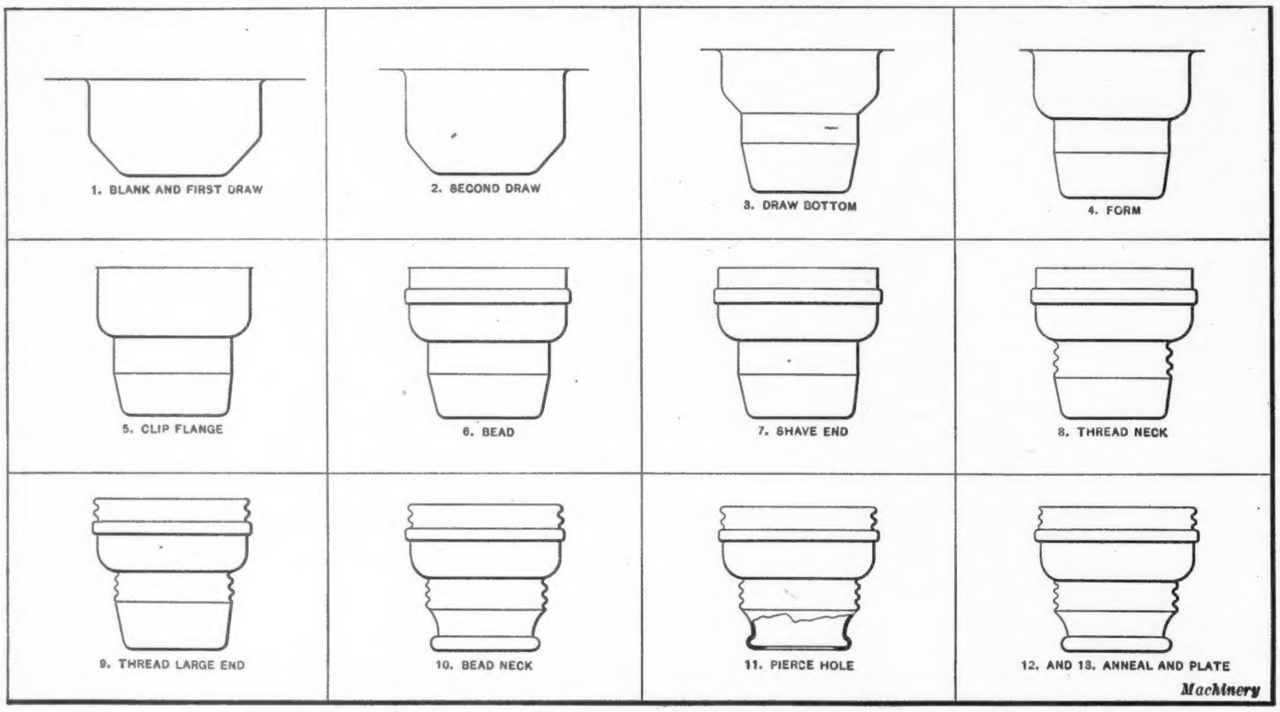


Fig. 1. Operation Sheet, showing Various Steps taken in drawing the Shell

Drawing a Deep Shell of Irregular Shape

Principal Details of Dies Used for Successive Operations in the Drawing and Forming of a Shell of Unusual Form

By CHARLES RUIZ

THE drawing of a deep shell depends upon a number of variable factors, and the rules for calculating the flow of metal are empirical. The formulas that have been developed as the result of experimentation pertain chiefly to shells of regular shape and are given in Volume II of MACHINERY'S Encyclopedia, page 411, and in "Diemaking and Die Design;" consequently they need not be presented in this article. When planning the drawing operations, not only must the amount of reduction in diameter permissible in each succeeding drawing operation be considered, but also the amount that the stock is "ironed" or thinned out while being drawn. This is true because the reduction in gage thickness means greater pressure of the punch against the bottom of the shell; consequently the amount that the shell diameter is reduced in each drawing operation must be lessened when a greater amount of ironing is necessary.

In arranging to manufacture an irregularly shaped shell, the rules pertaining to shells of regular shape cannot be applied, except in a general way. In the manufacture of the shell, the operations on which are described in this article, considerable planning was required on account of this fact. Shells of irregular shape must be carefully studied to determine the probable flow of metal, when planning and designing the tools for use in their production. The diameter of the blank was determined by weighing a sample, and then, knowing the weight of the sheet metal per square inch, computing the diameter of a piece which would be equal in weight to the sample. The diameter was then increased a certain amount, in this case, 5 per cent, to allow for trimming after the drawing operations were completed. This is necessary on account of the unevenness in the flow of metal due to irregularities in hardness and inaccuracies in setting the dies in relation to the punch. After the size of the blank was decided on, the process of manufacture and the requisite number of operations were determined. The most dependable factor to consider in this connection is the designer's previous experience, for there is no other way, to the writer's knowledge, to determine what the shapes should be after each successive operation. The planning and tooling are of utmost importance, as many dollars worth of tools can be saved by a little diligent study.

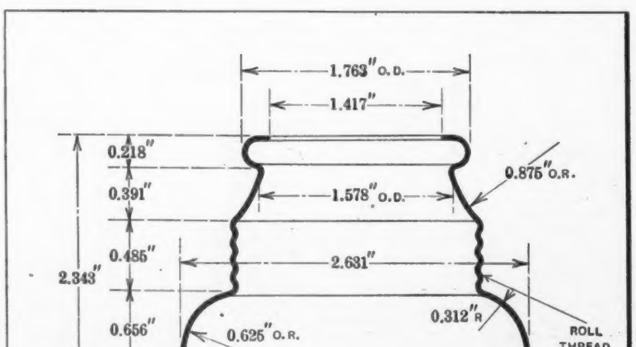


Fig. 2. Fully Dimensioned Illustration of the Finished Shell

Major Forming Operation for Producing the Shell

For convenience in following the various steps required in its evolution, an operation sheet, Fig. 1, and a completely dimensioned drawing of the shell, Fig. 2, may be referred to. The shell is made from sheet metal, 0.017 inch thick, and is blanked and formed to the shape shown by the heavy line in Fig. 3, in one operation.

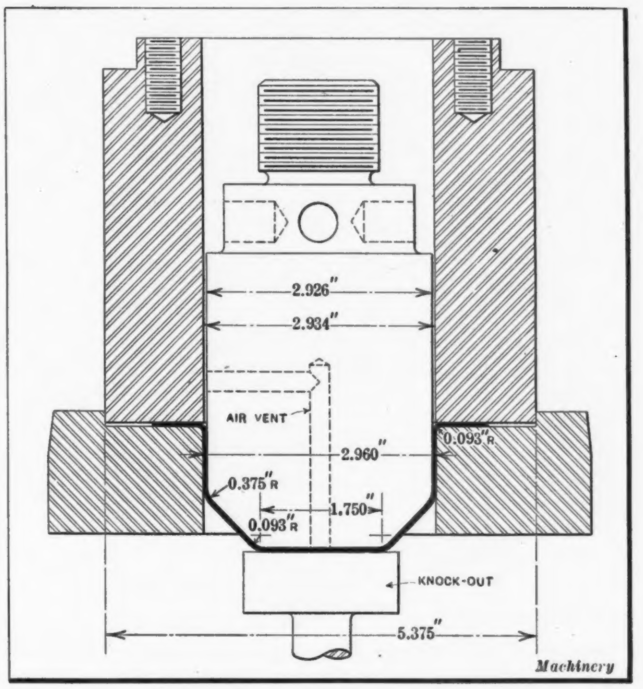


Fig. 3. Punch and Die used in the Blanking and First Drawing Operation

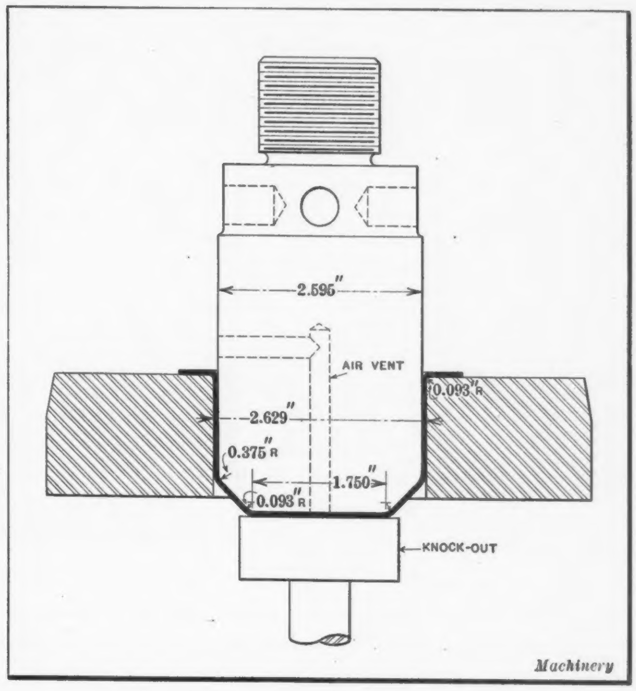


Fig. 4. Single-action Press Equipment for the Second Drawing Operation

The punch and die for this operation is used on a double-action press of standard construction equipped with a knock-out for ejecting the shell from the die. Fig. 4 illustrates the tools used in performing the second operation, which is simply a redrawing operation performed on a single-action press. It will be observed that all dimensions necessary for making the tools that are employed in the forming of the shell are given on the illustrations, and the construction is clearly shown in each case.

Operation 3 is performed with the tools illustrated in Fig. 5, and consists of drawing the bottom of the shell to the shape shown. Attention is called to the fact that the shape of the shell after Operation 2 is such as to enable it to fit the upper portion of the die used in Operation 3, and that sleeve *A* is so shaped as to hold the work while the plunger draws the bottom of the shell and forms the nose. This operation is also performed on a double-action press, the construction of the tools being similar to those used in the preceding operations as regards knock-outs, air vent, etc. Fig. 6 illustrates the tools used for forming the shell to the shape shown; this equipment contains no features to which attention need be drawn, except that the knock-out is made to bottom in a hole in the die-block so that the small end of the shell will be formed perfectly flat. Operation 5 consists of clipping the flange as shown in Fig. 7. This is a plain punch and push-through type of die with a hardened steel die ring *A* seated in the die-block. This operation which, with the exception of the final piercing operation, completes the press work on the shell, is performed on a single-action press.

Beading, Shaving, Threading, and Piercing Operations

The tools used for forming a bead on the large diameter of the shell are shown in Fig. 8. The work can be performed on an ordinary lathe by holding the form roller *A* in the toolpost and the arbor *B* in the headstock. It will be

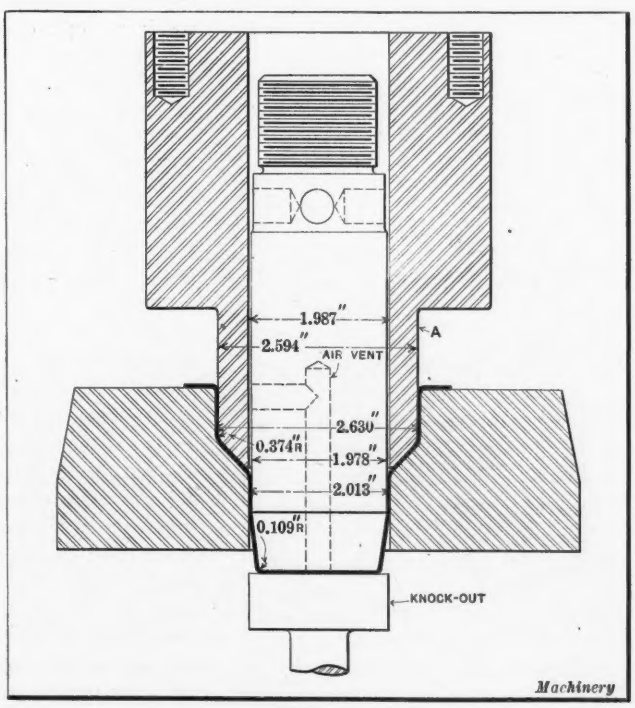


Fig. 5. Third Operation—Drawing the Bottom of the Shell on a Double-action Press

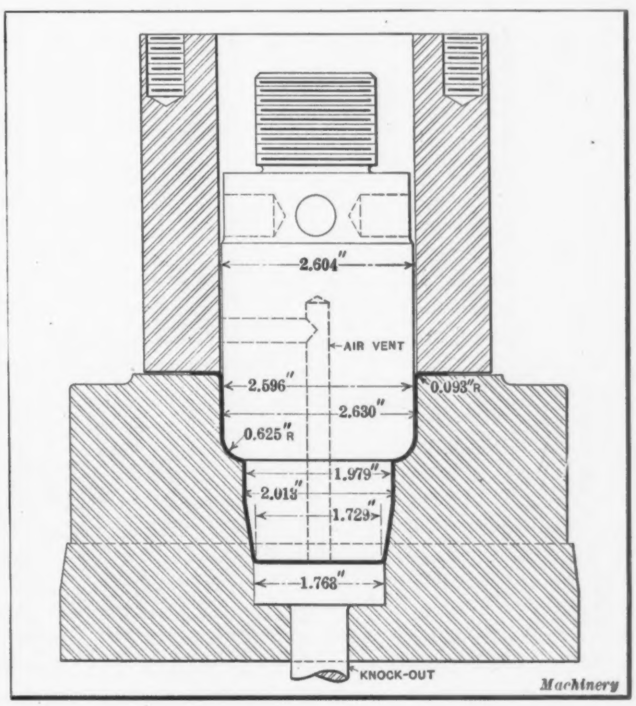


Fig. 6. Forming the Shell to the Shape shown and flattening the Small End

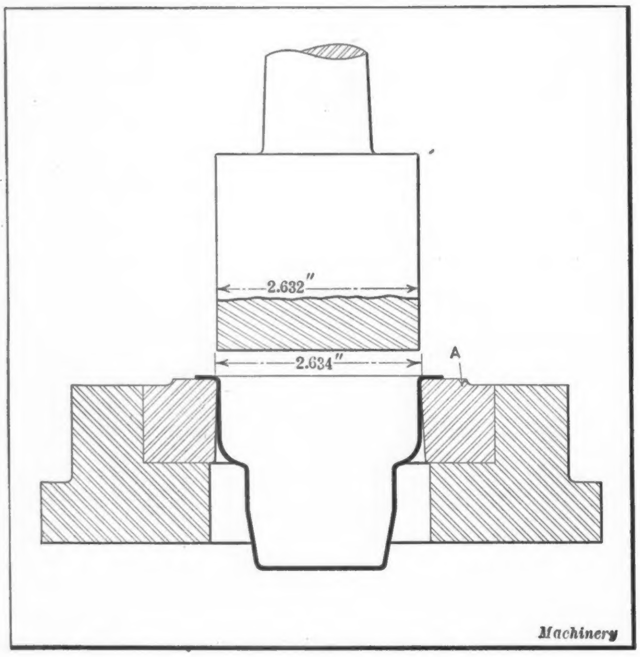


Fig. 7. Clipping the Flange. This Operation is performed on a Plain Push-through Die

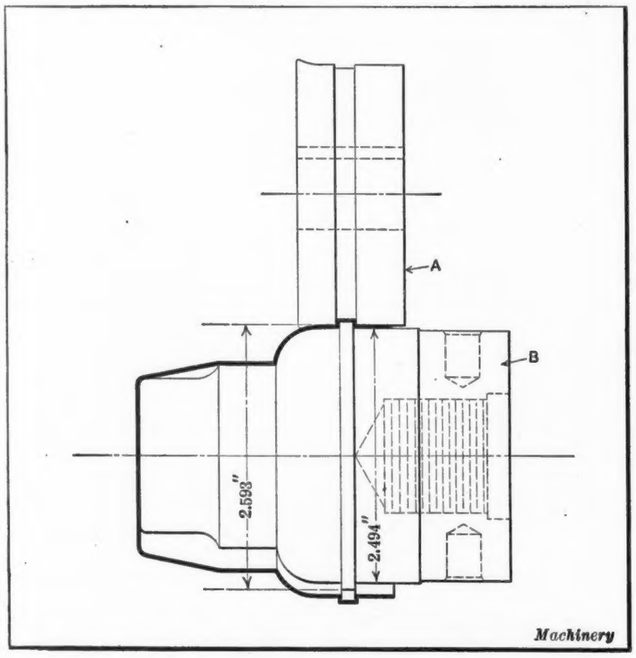


Fig. 8. Forming a Bead on the Large Diametral Surface of the Shell in a Lathe

seen that the important dimensions of the arbor are given—the diameter of the tongue used in forming the bead and the large diameter of the body. The arbor should be small enough in diameter to allow the shell to slip freely over it. Operation 7 consists of shaving the end of the shell, and the tools and arrangement employed are clearly shown in Fig. 9. While this work could be performed in a lathe, the operation can be done more economically on a vertical machine, with provision for locating the tool properly for shaving the shell to the correct length. In the vertical machine in which this operation was performed, the shell is driven by pressure between arbor *A* and sleeve *B*. These two members are mounted on opposed spindles of the machine which are connected to rotate in unison, and the tool is fed to the work automatically.

The rollers employed for threading the neck and large diameter of the shell are illustrated in Fig. 10 and at *A* in Fig. 11, respectively. These rollers are mounted on a special threading and knurling machine, and both the arbor and the rollers rotate by means of a positive gear drive. The shell is loosely mounted on the arbor which is made about 0.005 inch smaller in diameter than the inside diameter of the shell before threading. The arbor is single-threaded, and the threaded roller usually has a diameter of about two or three times that of the arbor, the gearing being such as to rotate the roller one revolution while the arbor is rotating either two or three revolutions, as the case may be. The size of the roller, however, should not be exactly double or triple the diameter of the arbor, because the thickness of the metal from which the shell is made must be taken into consideration. It will be apparent that the surface speed of the arbor and of the outside of the shell cannot be the same under these conditions, and the speeds must be calculated to take care of the increased speed of the outside of the shell, and not with respect to the speed of the arbor. The diameter of the roller should be either two or three times the sum of the outside diameter of the arbor plus twice the thickness of the metal. It follows that when the diameter of the roller is twice that of the outside of the shell on the arbor, the roller should be double-threaded; and when the diameter of the roller is three times that of the revolving shell, the roller should be triple-threaded.

The tenth operation, that of beading the neck of the shell, is performed like the beading operation shown in Fig. 8. The tools and the relation of the form roller to the work are illustrated at *B*, Fig. 11. The last machine operation, No. 11, is shown at *C*, and consists of piercing a hole in the bottom of the shell, the work being performed with simple tools on a single-action punch press. Due to the hardening or ironing that the metal receives during its manufacture, the shell requires annealing several times between the drawing and forming operations; the number required must be found by trial, and must be reduced to a minimum to lessen the cost of the shell. The last two operations do not require special mention.

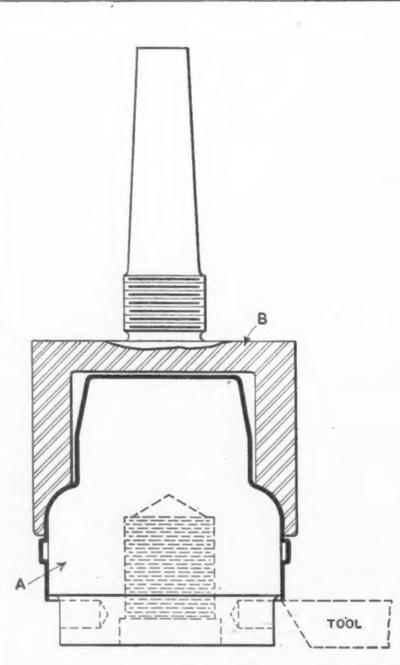


Fig. 9. Shaving End of Shell on Special Vertical Machine

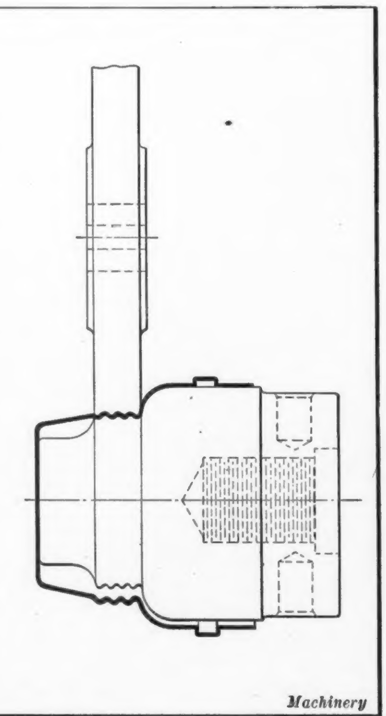


Fig. 10. Rolling a Thread on the Neck of the Shell

INCREASING VOLUME OF FOREIGN TRADE

It is not generally appreciated that the foreign trade of the United States now forms 17 per cent of our total commerce. As a result, foreign trade becomes of importance to everyone engaged in productive work. The workers in the industries of the country should realize that the products on which they work are largely sold abroad and that their continued prosperity and employment in many cases depends on the maintenance and development of foreign trade.

In the electrical industry for example, 25 per cent of the total production in generator sets in 1919 went abroad; and in the case of electric railway locomotives, over 60 per cent of those manufactured were for foreign buyers. In 1919 over 5000 American ships having a total tonnage of 6,665,000 were engaged in foreign trade. The total tonnage of vessels, both American and foreign, that cleared from American ports engaged in foreign trade in 1919 was over 51,000,000 tons, carrying exports valued at nearly $8,000,000,000.

Ten per cent of the total products of the electrical manufacturing industries in the United States during 1919 were exported. The total exports in this industry were valued at $90,000,000. Forty per cent of these exports went to our neighbors in North and South America; 25 per cent to the Far East and Australia; and 25 per cent to Europe, where Great Britain, Norway, France, Italy and Spain were our biggest customers. This high level of electrical exports during 1919 was attained in the face of unfavorable foreign exchange rates. But the demand for electrical products in Europe has been very urgent because of the necessity for utilization of hydro-electrical power for the industrial rehabilitation of Europe.

According to a pamphlet entitled "Sources of Our Exports" published by the National Foreign Trade Council, the National Automobile Chamber of Commerce is now endeavoring to have removed an obstacle that has proved a hindrance to the extension of our export trade of American cars in Europe. The proposal is that the present import duty into the United States, which is now 45 per cent on cars having an import valuation of $2000 and over, be reduced to 30 per cent upon cars of all values. The European countries, in fixing their import duties, have taken our rate as a sample, and have imposed correspondingly high duties upon automobiles imported into their countries. The adoption, by the United States, of a lower rate will, it is believed, induce a material lowering of European import duties on automobiles. It is stated that the entire membership of the Automobile Chamber of Commerce—123 companies—are unanimous in urging the reduction of our import duties on automobiles on the broad ground of general benefit to the automobile industry.

In 1919, 4 per cent of the automobiles manufactured in this country were exported—67,000 passenger cars valued at $74,000,000 and 15,500 trucks valued at $35,000,000. In addition to this, parts were exported to a value of $43,000,000 making a total export of automobiles, trucks, and parts of $152,000,000.

* * *

THE PRESENT POSITION OF THE SHIPBUILDING INDUSTRY

From Lloyd's shipbuilding reports it appears that there were 2195 merchant vessels in the course of construction in all parts of the world on June 30, this year, representing a gross tonnage of about 7,700,000 tons. Of these 941 ships, aggregating 3,580,000 tons, were under construction in the United Kingdom, while a tonnage of 2,106,000 tons was under construction in the United States. The total available tonnage of steel steamers owned in the United Kingdom is 18,110,000, which is about 780,000 tons less than in 1914. The United States at the present time owns a tonnage of 12,400,000 as compared with 2,027,000 tons in 1914. At the outbreak of the war in 1914, the total steel steamship tonnage of the world was 45,400,000. At present this total is nearly 54,000,000 tons, most of this increase having been completed in the last twelve months, in which period 6,000,000 tons have been built.

* * *

The state of New York has appropriated $50,000 for establishing scholarships for teachers in industrial training schools. These scholarships amount to $2000 each, and will be given only to men who have at least five years successful experience in some industrial or technical occupation. It is expected in this way to meet the requirements for teachers who know their trade and who would like an opportunity to learn how to teach it. Five years of practical experience and one year of training in the vocational department of an institution for training vocational teachers ought to equip a man for this work, provided he is otherwise fitted for it by temperament and inclination.

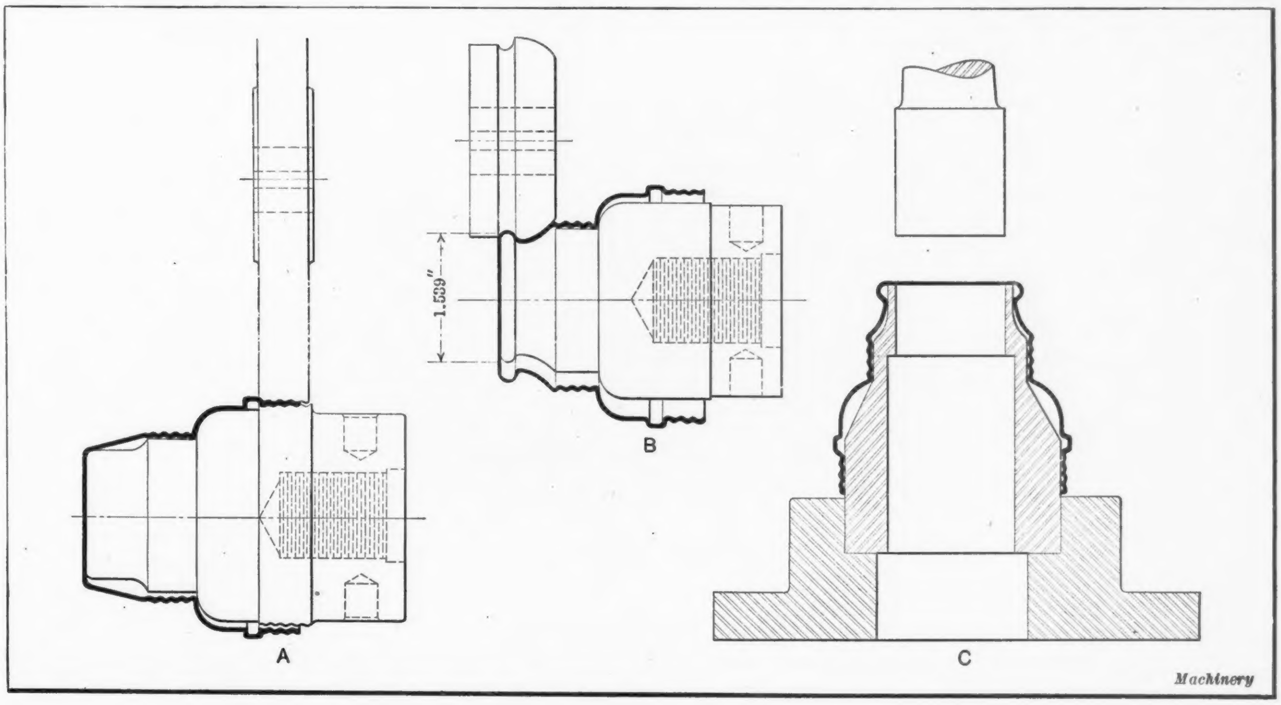
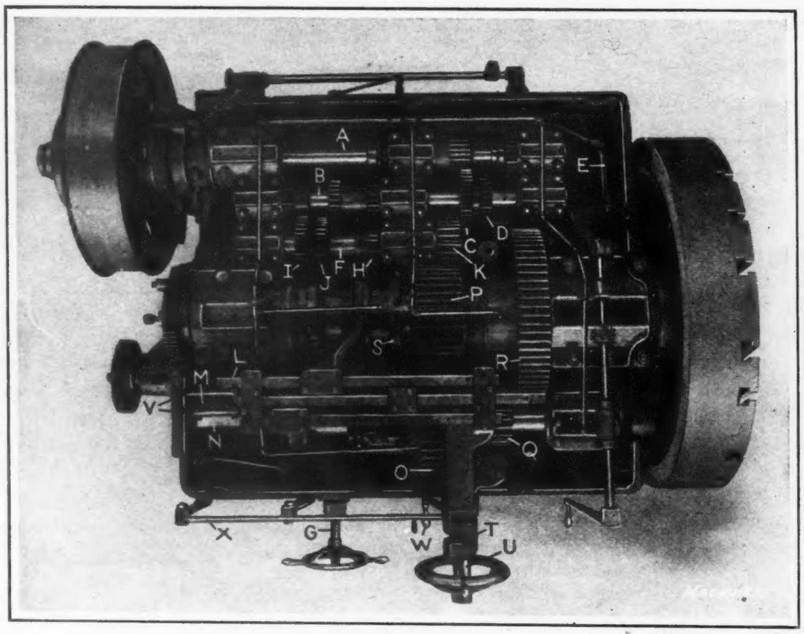


Fig. 11. (A) Threading the Large End. (B) Beading the Neck. (C) Piercing Hole in End of Shell

Geared-head Transmission for Lathes

WHILE the construction of gear-head drives for lathes is generally understood, a detailed description of such a mechanism will doubtless prove of interest. The design illustrated herewith is the transmission gearing and mechanism contained in the headstock of a 60-inch engine lathe and contains certain unique features of design. The speed changes, of which there are eighteen provided, are of the selective type, and the shifter-bar arrangement is similar to the gear transmission on an automobile.

The initial driving shaft *A* operates at a constant speed and transmits two speeds to the long auxiliary shaft *B*, according to which of the two gears *C* and *D* is in mesh with the driving shaft gear. The friction clutch for the driving pulley (or for the driving gear if the lathe is motor driven), and the brake are operated by handle *W*, the clutch being connected by a long rod to the bell-crank lever *E*, which prevents shifting of gears *C* and *D* except when the friction clutch is disengaged. These gears are operated by the handle shown near the faceplate of the lathe. The movement of the crank-handle to the right disconnects gear *C* and brings gear *D* into mesh with its mating gear. The design of lever *E* is such as to prevent engagement of the friction clutch when the gears are in the neutral position or when they are not fully in mesh. The operation of the friction clutch also controls a speed-change locking mechanism, consisting of fingers *V* which carry pins for engaging slots in the shifters and locking them together in series. The connecting link and the arm attached to bar *X* are plainly seen in the illustration from which it will be apparent that the manipulation of handle *W* simultaneously engages the friction clutch and prevents the shifting of the gears when the driving pulley is connected with the initial driving shaft of the geared head.



Arrangement of Gears and Clutches in Headstock of 60-inch Geared-head Engine Lathe

The two speeds of the long auxiliary shaft *B* furnish six speeds for the short auxiliary shaft *F* which may be obtained in the following manner. There are two racks located under shaft *F* and parallel with it, which may be engaged by a pinion on the end of the operating shaft *G*. One of these racks operates sliding gear *H* by means of a gear-shifting fork which it carries, while the other operates gears *I* and *J* by similar means, to mesh with either of the two smaller gears on shaft *B*. The six speeds which are thus obtainable for gear *K* may transmit eighteen speeds to the faceplate of the lathe by means of two combinations of gears and one sliding clutch. The gear shifters *L*, *M* and *N* are operated by shaft *U* for the purpose of obtaining these three transmission combinations.

When driving through the faceplate pinion (which cannot be seen in the illustration), gear shifters *L* and *N* occupy the left-hand position shown in the illustration, while shifter *M* is moved to the right thus engaging a sliding gear (not visible) with pinion *Q*. The drive is then through the spindle gear *P*, which is an idler, to the faceplate pinion-shaft by means of pinion *Q* and its engaging gear. In the second method of driving the faceplate, shifter *L* remains as before, leaving gear *P* loose on the spindle, and shifter *M* is moved to the left withdrawing the faceplate pinion from mesh with the faceplate gear. Shifter *N* is slid to the right-hand position which results in sliding the faceplate pinion-shaft, so that pinion *Q*, which is fast to it, will be brought into mesh with the fixed spindle gear *R*. The drive is then through gears *P*, *O* and *Q* to spindle gear *R*. The third drive is direct to the lathe spindle. In this case, shifter *N* is moved to the left, to the position shown in the illustration, disengaging pinion *Q* and gear *R*, after which shifter *L* is moved to the right, engaging tooth-clutch *S* with gear *P*. In this case the faceplate pinion-shaft revolves, but is inoperative.

The three shifters *L*, *M*, and *N* are controlled by the operating shaft *U*, which contains a projecting finger that engages slots in the shaft bearing *T* when operating the shifters. This arrangement is provided so that after each shift of gears is made, it becomes necessary to turn the operating shaft in the opposite direction, until the end of the slot is reached, so as to disengage the drive before shifting to the next speed. This prevents the selection of gears having a conflicting ratio and furnishes a stop against which the finger on the shaft *U* must be abutted when the gears or clutch are placed in full engagement. When thus engaged, the positions are locked by the device previously mentioned so that they cannot be changed until the friction driving clutch is disengaged. This same construction for selecting the speed changes is provided for shaft *G* and is a modification of the lever gate or H-plate used in automobile gear-boxes.

The center lines of all gears in this head lie in the same horizontal plane and are lubricated by an oiling system in which the oil is forced through pipes located over the various journal boxes, into each of which a stream of oil is constantly directed. The sprocket wheel for the oiling system, from which the centrifugal pump is driven by means of a chain, may be seen on the initial drive shaft, near the middle bearing. Shafts *A*, *B* and *F* together with their bearings and the ten gears which they carry, constitute an individual unit which is assembled independently of the other gears, shafts, etc. This facilitates the assembling process, since this unit is simply set into the headstock housing and after gears *K* and *P* are brought into mesh, is attached by bolts to the headstock casting. The eighteen speeds of this gear-head range from 1.63 to 115.5 R. P. M. The lathe on which this head is used is manufactured by Manning, Maxwell & Moore, Inc., Putnam Machine Works, Fitchburg, Mass.

Electro-percussive Welding Developments

IN a paper presented before the American Welding Society at Pittsburg, Pa., by Douglas F. Miner, research engineer, Westinghouse Electric & Mfg. Co., recent developments in electro-percussive welding were considered, together with the advantages of the process. This method of welding is particularly suitable for manufacturing large quantities of duplicate parts because one size of machine will handle a large variety of work over a considerable range of size; but on account of the necessity of having different fixtures for various kinds of work, the investment in fixtures is likely to be too great if only a small number of identical parts is to be welded. Thus, it will be apparent that repair work is not its most suitable field. There is a great opportunity for developing automatic machines for utilizing this process inasmuch as the time required for welding is negligible and the only factor limiting production is the time required to feed and grip the work.

A study of the parts of a well-known automobile showed that over fifty of the parts could be produced better by percussive welding than by present methods. The manufacturing costs of many types of tools having a special cutting portion attached to a shank of cheaper material can also be reduced by this process and better results obtained. Besides this, there are numerous hardware articles having unlike metals or unequal sections welded together which can be advantageously produced by electro-percussive welding.

Development of Apparatus Using Electro-magnetic Energy

The underlying principles utilized in percussive welding were discovered in 1905 by L. W. Chubb of the Westinghouse Co., and machines were developed for welding metals in wire form of rather small cross-sections. (A complete description of the principles of the system was published in MACHINERY June, 1915, and is also published in the book "Electric Welding" by Hamilton and Oberg.) Satisfactory welds were made between wires having widely different physical properties, perfectly ductile welds being made with platinum and lead, tungsten and aluminum, and copper and aluminum. The apparatus consisted essentially of a device producing a percussive engagement of the parts to be welded practically simultaneously with a discharge of electrical energy, this energy being taken from an electrolytic condenser. However, a condenser proved to have decided limitations on account of the small amount of energy capable of being stored in one of convenient size; consequently, a scheme was evolved for utilizing electrical energy stored in a magnetic field, thus substituting electro-magnetic for electro-static energy. An apparatus using electro-magnetic energy has been developed, and very successful welds of the butt type have been made with stock having a cross-sectional area equivalent to that of ½-inch diameter stock.

In order to permit a better understanding of the apparatus a brief description of its operation will be given. Stated in simple terms, when any electrical circuit containing large inductance, such as a coil of many turns, is interrupted, the stored energy tries to prevent the break and causes an arc to be drawn. An electric arc is a source of high intensity heat particularly well suited to welding operations. In the apparatus there is a reactance coil of two windings, a primary coil being connected momentarily to a source of direct current, and a secondary coil being connected to the pieces to be welded. By means of suitable tripping devices the forging hammer causes the primary coil to be disconnected from the source of power, with the secondary coil closed. The transferal of the energy of the collapsing magnetic field to the secondary coil occurs and then a rapid small separation of the parts to be welded causes an intense arc to melt the surfaces of the work. At the proper moment the hammer forges the pieces together, the complete operation requiring only about 0.1 second, so that no time is allowed for oxidation or excessive heating. An oscillogram taken during a weld between copper and steel rods ⅜ inch in diameter indicated a peak of current of 2600 amperes, an arc of 30 volts, a maximum power of 60 kilowatts, an energy of 0.00077 kilowatt-hours, and the welding time as 0.094 second.

Advantages of Electro-percussive Welding

The power necessary for percussive welding is only about one-quarter of that required in welding the same size of stock by the butt-welding process. The operation is so rapid that the time of the actual weld is negligible and so the rate of production depends chiefly on the time consumed in handling the work. A time study of a number of operations employing other methods of welding has shown that the saving in time obtained by the use of percussive welding allows a remarkable increase in production or a reduction in labor costs. The short duration of the fusing arc in the percussive process allows no chance for the heat to travel back into the metal when the two pieces of work are of unequal section. The necessary energy is concentrated in a very small amount of material, utilized where needed, and not dissipated in heating up the rest of the stock. Consequently, welds such as a small rod to a heavy plate or a tube to a block, are possible. No preparation of the surfaces or previous treatment is necessary; this feature opens up a wide field of application permitting the welding of some products formerly impossible, and improving the methods of manufacture on some products now being made by other welding processes.

In many manufactured products it is desirable to join brass or copper parts to parts composed of steel, and percussive welding solves many of these problems without the use of screws, bolts or rivets. Steel alloys can also be welded to cold-rolled steel. Percussive welding permits the welding of parts, the physical structure of which the heating caused by other methods either destroys or changes, such as drawing the temper. Welds can be made after any treatment has been given to the work without changing the condition of the structure, because of the localized heat of the weld. Immediately after the weld is completed the piece can be handled and no appreciable warmth can be felt. This is a feature which is valuable in tool manufacturing. After the proper setting for a given weld is made the character of the weld is always uniform and independent of the skill of the workman, so that the machine may be operated by unskilled labor without danger of poor results. With most other welding processes the judgment of the operator must be relied upon to a large extent and the chance of faulty work is large. The percussive process produces a much smaller fin or flash than butt-welding, thereby decreasing the cost of finishing. In fact, for many purposes, finishing operations are unnecessary.

* * *

The serious post-war problems of Germany are perhaps best exemplified by the inefficiency of German labor in the coal fields. According to *Stahl und Eisen*, there are in the Ruhr coal mines at the present time in round figures 70,000 more men actually employed than immediately preceding the war, yet the total output is only 60 per cent of the output in 1913.

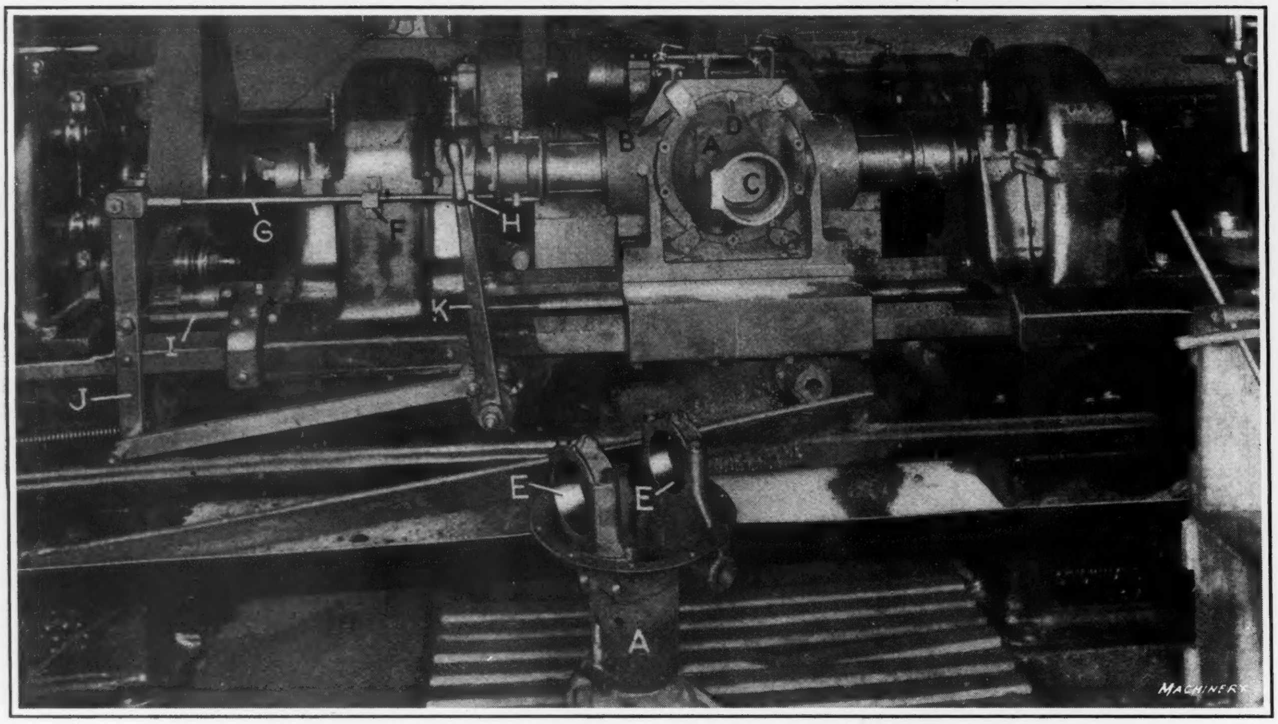


Fig. 1. Special Duplex Boring and Tapping Machine developed for machining Differential Gear Carriers

Shop Practice in an Axle Plant

Methods of Machining and Equipment Employed in the Plant of the Timken-Detroit Axle Co., Detroit, Mich., for Obtaining High Production

MEN who have an opportunity of frequently observing machine shop practice in different industries are usually of the opinion that the methods used in motor car plants and factories engaged in manufacturing automobile parts and accessories are among the most efficient. The reason ascribed for this is that many of these plants were planned and built for a predetermined volume of product and as a result, it was possible to provide many improved methods which are not applicable in plants that have been developed by a gradual process of evolution. Another feature of the average plant in the motor car industry is the care that has been taken in developing the factory organization, making provision for carefully studying the requirements of each new shop operation, with a view to providing a method which will enable the job to be done in an economical manner. Similarly, old methods are not allowed to remain in use after it becomes evident that the work could be done at a lower cost in some other way. Probably it is safe to say that there is no industry in which a greater amount of money is spent on the planning of methods of machining and in the replacement of existing equipment with machines of more efficient types.

Examples of Shop Practice in the Timken-Detroit Axle Plant

At the plant of the Timken-Detroit Axle Co., in Detroit, Mich., the normal daily rate of production is 600 axle sets which are used in Cadillac, Hudson, and other well-known motor cars. There are few plants in which each detail of manufacturing practice is more carefully scrutinized with a view to eliminating every possible source of inefficiency. One method of improving operating conditions is to have an industrial engineer of wide experience come to the plant for one week out of each month and spend his time investigating both the methods of performing machining operations and the details of construction of individual machine tools, the latter part of the work being done with a view to ascertaining their suitability for the particular purposes for which they are used.

Based upon the periodical reports of this expert, and upon the findings of men who are constantly engaged upon similar work at the Timken plant, the design of the machines is constantly being modified to make them more perfectly adapted for the peculiar requirements that must be fulfilled in manufacturing axle parts. For instance, it may be found that by strengthening gears, shafts, or other members of the driving mechanism, coarser feeds and higher speeds can be employed. The making of such changes involves an expenditure of time and money, but the return in increased production far more than offsets this expense. In a plant where such careful attention is paid to every detail one would naturally expect to find interesting and highly efficient methods of performing machining operations. The following examples were selected for discussion in MACHINERY both on account of the interesting means provided for handling the work and the satisfactory rates of production which are obtained, and also because, while these methods are used for machining axle parts, they could be employed with slight modifications for producing many similar classes of work.

Turning the Thread Bearing and Taper on Steering Arms

There are several different types of steering arms used in Timken axles, but in machining all of these parts it is necessary to turn a straight thread bearing at the end of the arm and a tapered fit above the straight cylindrical surface. After using various methods for handling this job, the work was put on engine lathes provided with special equipment of the form shown in Fig. 2 and this has proved capable of giving highly satisfactory results. In this illustration the straight thread bearing is indicated at *A* and the tapered portion at *B*, and it is important for a square shoulder to be formed between surfaces *A* and *B*. Referring to the illustration it will be evident that a cat-head is mounted on the lathe faceplate, with V-blocks on this cat-head for supporting and driving one end of the work, while the opposite end of the forging is supported by a tail-center. For obtaining the required straight and tapered portions of the turned surface,

a cam C is furnished at the front of the machine which engages a contacting point that is secured to the cross-slide.

As previously stated, it is necessary to have a square shoulder between surfaces A and B, and this result is obtained by having a similar shoulder between the straight and inclined faces of the cam. The contactor or sliding member that bears against cam C is provided with a square corner so that it is able to drop straight down the shoulder of the cam to produce the required form of shoulder on the work. The fixture is provided with a hand-lever D which is connected with the "Lo-swing" tool-block used for this job, and the operator holds this lever in his right hand to supplement the action of a spring that holds the contactor in engagement with the cam. By so doing, he insures having the contactor follow the contour of the cam while passing over the shoulder and thus insures an accurate form for the work that is being turned. It will be evident that the purpose of bracket E and rod F is to hold the support for cam C in a stationary position on the lathe bed, while lever D and the contactor that runs over cam C are mounted on the cross-slide so that these members travel with the carriage. On this job the rate of production obtained is 20 steering arms per hour.

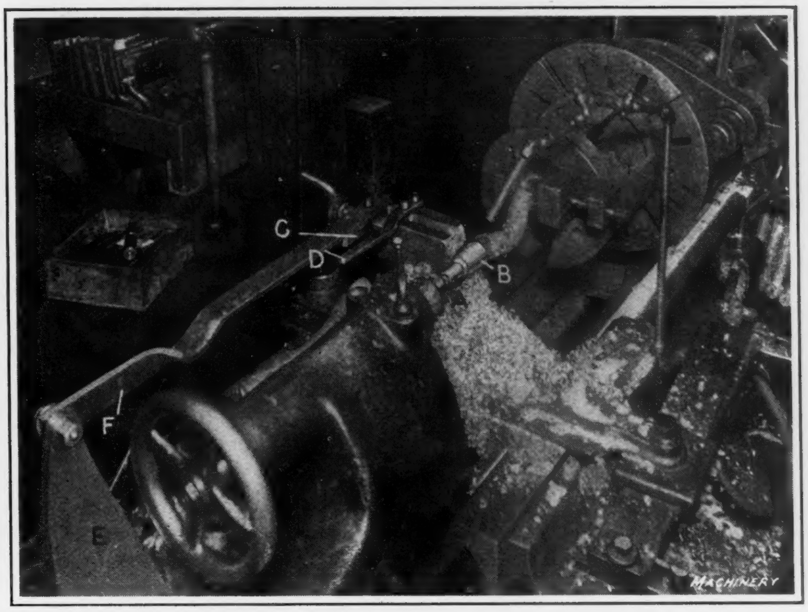


Fig. 2. Engine Lathe equipped with a Special Combination Straight and Taper Turning Attachment

Rough- and Finish-boring and Tapping the Differential Bearing in Differential Gear Carriers

Special duplex lathes were built for the Timken-Detroit Axle Co. by the National Lathe Co., of Cincinnati, Ohio, which make it possible to perform the necessary boring and tapping operations on the differential bearings at both ends of the differential gear carriers without requiring the work to be reset. Referring to Fig. 1 it will be evident that one of these malleable iron castings A is shown set up in place on the machine while a second casting will be seen standing in the foreground to give a better idea of the operation to be performed. Between the opposed spindles of the machine used for handling these parts, there is a work-holding fixture provided with a vertical plate B against which the work is clamped. Before the castings come to this duplex lathe, the hole has been bored in the sleeve on which the casting is shown standing in the foreground, and this finished bore is used as a locating point by having a pilot C secured to the fixture, this pilot being of the proper size to enter the bored hole.

Small holes have also been drilled in the flange of the work, and one of these holes constitutes a locating point by fitting over a pin D. With the work set up in this way the operator is ready to start boring and tapping the differential bearing holes E. The two opposed spindles of the duplex lathe are furnished with combination rough- and finish-boring bars and collapsible taps which are arranged to operate successively, so that the three operations are finished at a single feed movement of the lathe heads along the bed of the machine. Both the feed and the return movements are automaticaly controlled so that after the work has been set up and the machine started working on one casting, the operator can give his attention to a second machine, while the first one is occupied on the operation upon which it has just been started.

Automatic Control of the Feed Movements

Automatic control of the movements of the lathe heads is obtained in the following manner: Each head moves forward

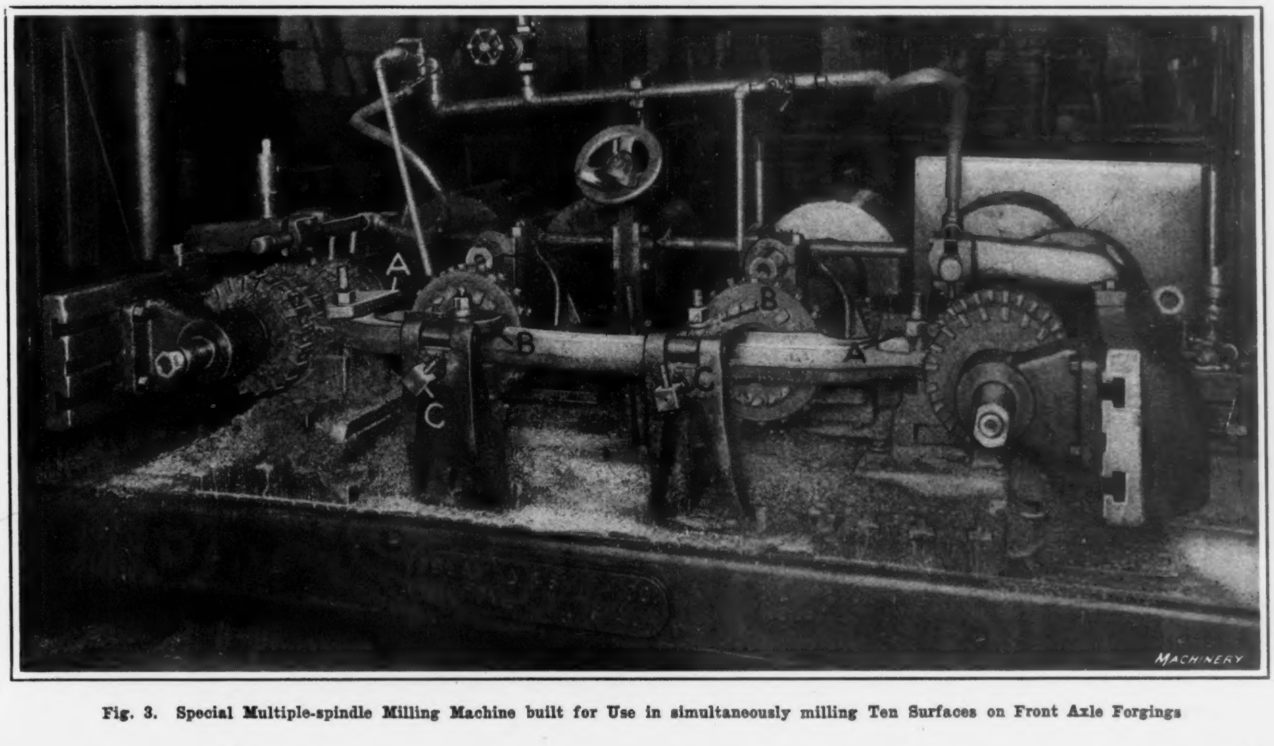


Fig. 3. Special Multiple-spindle Milling Machine built for Use in simultaneously milling Ten Surfaces on Front Axle Forgings

until the rough- and finish-boring tools and the taps have been fed through their respective holes E in the work. After this has been accomplished a bracket F carried on one of the lathe heads and arranged to slide over horizontal rod G, comes into engagement with nut H, and further movement of the lathe head results in pulling rod G forward to throw the clutch out of engagement with the "forward" feed-gears and into engagement with the "reverse" gears. Then the lathe head returns at high speed until rod I secured to the lathe head, comes into contact with lever J and throws this lever over to disengage the reverse gears and throw the clutch into a neutral position. Then feed movement of the head stops until such time as the operator has removed the finished piece from the machine and set up a fresh casting in its place. One feed control mechanism suffices for the operation of both heads on the machine because this mechanism imparts a forward or reverse movement to the feed-screw which operates both of the heads. After a fresh piece of work has been set up, the clutch is re-engaged with the forward feed-gears by means of a handle K, and when this has been done the operator is ready to give his attention to another machine in the manner previously described. On this job the rate of production obtained is 70 differential gear carriers from each machine in eight and one-half hours.

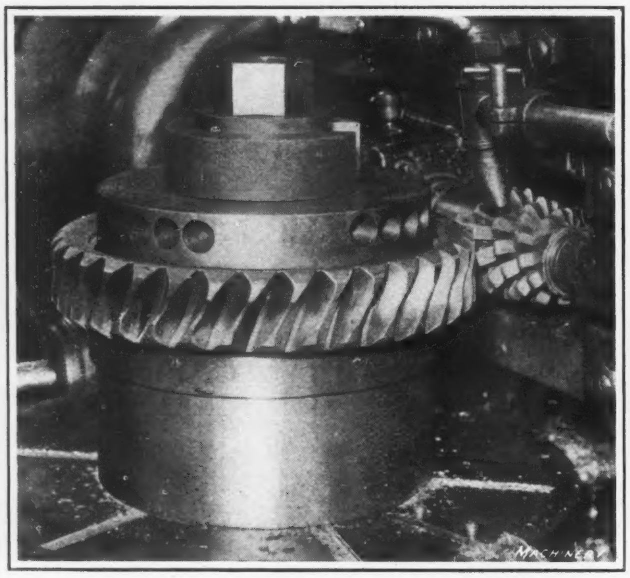


Fig. 4. Gear Generating Machine equipped with a Special Hob that is fed tangentially across the Worm-wheel for roughing and finishing the Teeth

Special Multiple-spindle Milling Machine for Operation on Front Axles

Fig. 3 illustrates a special multiple-spindle milling machine built by the Beaman & Smith Co., of Providence, R. I., to provide for the performance of milling operations on front axles. This machine provides for simultaneously milling two spring pad seats and four faces on each yoke of the axle, making a total of ten faces which are milled on the work at a single setting. On each end of the machine it will be seen that there are two pads or brackets on which the yokes at each end of the axle are held down by straps A, while there are two seats near the center against which the work is held by straps B. These center clamping members are also furnished with screws C which are tightened against the work to help support the pressure of the face-milling cutters. With the forging set up in this manner, it is evident that provision must be made for feeding the cutters across the face of the work, and this result is accomplished by imparting a longitudinal movement to the cutter-heads and holding the work stationary. The two outside heads carry a gang of four cutters each which provide for straddle-milling the upper and lower projections of the yoke on each end of the front axle forging. These cutter-heads are fed in toward the work to give this result. Similarly, a longitudinal movement is imparted to the heads carrying facing cutters that mill the spring pad seats near the center of the forging, but these heads are fed out toward the ends of the work. In operating this machine, manipulation of a single lever provides for simultaneously returning all of the cutter-heads to their starting positions. Owing to the hardness of the forgings to be milled, pipes are arranged to deliver a copious flow of coolant to each of the cutters. On this job the rate of production obtained is 7 axles per hour.

Advanced Practice in Hobbing Worm-wheels

For use in hobbing the various sizes of worm-wheels that are used in rear axles of its manufacture, the Timken-Detroit Axle Co. has adopted the use of the form of hob which has its forward end tapered and provided with a thread of variable lead on the tapered section. Behind this part of the hob there is a cylindrical section with a thread of uniform lead. The lead of the thread on the tapered section of the hob gradually increases until it coincides with the uniform lead on the cylindrical section. The tapered section of the hob is utilized for roughing out the worm-wheel teeth, and the cylindrical section finishes the teeth as the hob is given a tangential feed movement over the worm-wheel by means of suitable mechanism provided on the machine. Fig. 4 illustrates a close-up view of a gear-hobber developed by Gould & Eberhardt of Newark, N. J., for the application of this principle of gear hobbing. This method is the means of effecting a substantial increase in the rate of production, because a roughing and a finishing cut can be taken at a single setting of the work, and the teeth are roughed out by a section of the hob which is utilized exclusively for that purpose, leaving the finishing section to take only a light final cut to assure accuracy. As a result, it is a long time before the hob is worn to an extent which would affect the accuracy of the finished work. A high cutting speed and heavy feed can also be utilized with a hob of this type. On the present job, the hob runs at 120 revolutions per minute and the table at 14 revolutions per minute. The feed per table revolution is 0.052 inch. In the January, 1919, number of MACHINERY a description was published of a special lathe developed by the T. C. M. Mfg. Co. for relieving hobs of this particular design, so that this subject does not call for attention in the present article.

* * *

NEW DIESEL ENGINE

A new two-cycle marine Diesel engine, embodying in its design new features especially adaptable for American operating conditions, has been brought out by the Bethlehem Steel Corporation in conjunction with the Bethlehem Shipbuilding Corporation, Ltd. This engine is intended for stationary use as well as for cargo vessels of any size. One of the engines built in accordance with this design was installed at the power plant of the Bethlehem Steel Corporation, at Bethlehem, Pa., and was operated for ten months for stationary purposes. It was then installed in an ore-carrying vessel which recently completed a voyage to Cuba and back. The ore vessel made the voyage to Cuba and back on one-third the amount of fuel that would otherwise be consumed by an oil-burning cargo vessel of the same size, and it is claimed that the economy was greater than has been achieved by any present type of Diesel engine. Further details on this point, giving specifically the size of engine, size of vessel, speed and oil consumption would, of course, be necessary before any definite judgment can be passed upon the superiority of the new engine over those developed and built in the past.

* * *

A recent commerce report containing a general summary of the economic conditions in Brazil for the past year, states that all of the railway supplies, rolling stock, and equipment obtained for the government-owned railways, as well as for other railways in Brazil have been purchased from American firms.

Chordal Thickness of Tooth and Corrected Pitch Depth of Bevel Gears

By C. W. MAPES

THE tooth profile of a bevel gear is based on the back cone distance, and because of this fact, there has been some confusion regarding the calculations for determining the chordal thickness and "corrected pitch depth" or corrected addendum. The formula for determining the chordal thickness should be based on the pitch radius of the bevel gear, the chordal thickness of a bevel gear tooth being the same as that of a tooth on a spur gear having the same pitch and number of teeth. The formula for corrected pitch depth may be based either on the pitch radius or the back cone radius, as the results in either case are sufficiently accurate for practical purposes. However, the formula based on the pitch radius is somewhat simpler as will be shown later. The chordal thickness will be considered first.

The points P and P_1 (see accompanying illustration) are the points between which the chord is measured. These points lie on the pitch line, and therefore the pitch circle passes through them. Since similar points on all the teeth in the gear also lie on the pitch line, the pitch circle must pass through all the points, forming a complete circle whose diameter is equal to the pitch diameter; therefore, the calculation for length of chord should be based on the pitch diameter.

To more clearly illustrate the case, take, for an example, a gear of 8 teeth, 1 diametral pitch, 60-degree pitch cone angle, with a standard Brown & Sharpe form of tooth. The space between pitch points P_1 and P_2 will be equal to the distance PP_1 or the chordal thickness C. By joining all the pitch points, P, P_1, P_2, etc., with straight lines, a sixteen sided polygon with each side equal in length to the chordal thickness C of the tooth, or 1.5608 inches is formed. As these points lie on the pitch line, the pitch circle circumscribes the polygon. Calculating the chordal thickness with the back cone distance as a basis, gives a length of side of the polygon of 1.5682 inches. A circle circumscribing such a polygon would be 8.0385 inches in diameter; therefore, the points could not lie on a pitch circle of 8 inches diameter.

In the formula for determining the chordal thickness of tooth, the following notation is used:

C = chordal thickness;
R = pitch radius;
T = thickness of tooth on pitch circle.

$$C = 2R \sin \frac{90T}{R\pi}$$

For a Brown & Sharpe standard tooth,

$$C = 2R \sin \frac{90}{N}$$

The corrected pitch depth A is the distance from the end of the tooth to the pitch points P and P_1, measured as indicated in the illustration. The chord being measured on the radius R, F is the height of the arc. The corrected pitch depth A will be equal to the pitch depth H plus B which is one side of a right-angle triangle of which F is the hypotenuse and θ the angle between them. Therefore,

$$B = F \cos \theta \text{ and } F = R - R \cos \omega$$

Then

$$B = \text{Cos}\, \theta\, (R - R \cos \omega) \text{ and } A = H + \cos \theta\, (R - R \cos \omega)$$

$$\omega = \frac{90T}{R\pi}$$

and

$$A = H + \cos \theta \left(R - R \cos \frac{90T}{R\pi} \right)$$

which is the general formula for the corrected pitch depth of bevel gears, based on the pitch radius.

For a Brown & Sharpe standard tooth, the formula for the corrected pitch depth, based on the pitch radius, is:

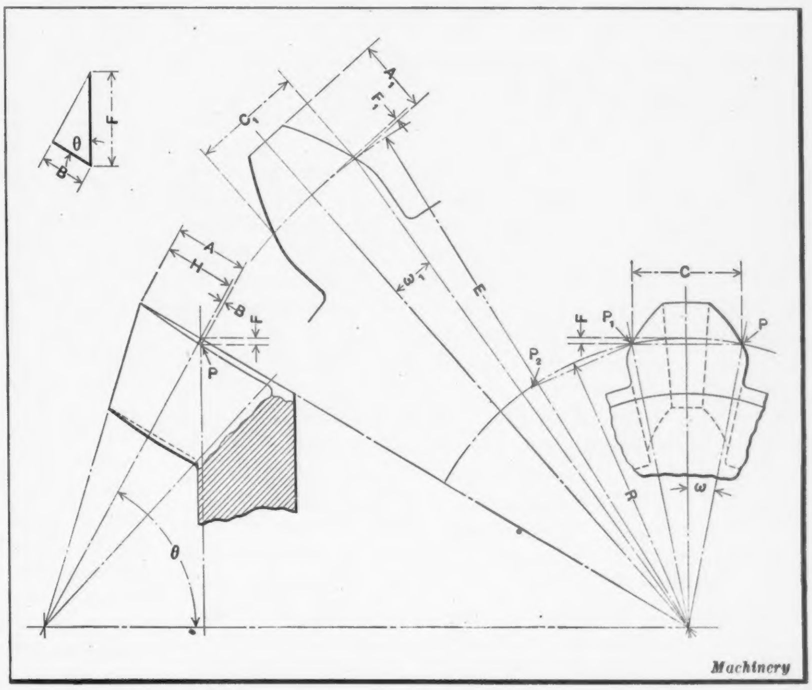


Diagram showing Dimensions and Angles used in determining the Chordal Thickness and Corrected Pitch Depth of Bevel Gear Teeth

$$A = H + \cos \theta \left(R - R \cos \frac{90}{N} \right)$$

The general formula based on the back cone distance is:

$$A_1 = H + E - E \cos \omega_1$$

$$E = \frac{R}{\cos \theta}$$

$$\omega_1 = \frac{90\, T \cos \theta}{R\pi}$$

Therefore,

$$A_1 = H + \frac{R}{\cos \theta} - \frac{R}{\cos \theta} \times \cos \frac{90\, T \cos \theta}{R\pi}$$

$$= H + \frac{R - R \cos \dfrac{90\, T \cos \theta}{R\pi}}{\cos \theta}$$

The formulas for A and A_1 give practically the same results. Substituting the values of the example previously given, in the formula based on the pitch radius,

$A = 1 + 0.5\ (4 - 4 \times \cos 11\text{ deg. }15\text{ min.}) = 1.0384$ inches

Using the same values in the formula based on the back cone distance,

$$A_1 = 1 + \frac{4 - 4 \times \cos \dfrac{90 \times 1.5708 \times 0.5}{4 \times 3.1416}}{0.5}$$

$$= 1 + \frac{4 - 4 \times \cos 5\text{ deg. }37\text{ min. }30\text{ sec.}}{0.5} = 1.0385 \text{ inches}$$

It might be supposed that this slight discrepancy in results is due to not carrying decimal places far enough, but substituting 1 for R and leaving the other quantities as before,

$$A = 1 + 0.5\ (1 - 1 \cos 45\text{ deg.}) = 1.1464 \text{ inches}$$

$$A_1 = 1 + \frac{1 - \cos 22\text{ deg. }30\text{ min.}}{0.5} = 1.1522 \text{ inches}$$

The difference in results in this case is sufficient to prove that the formulas are mathematically different. As will be seen, the simplest formula to use for calculating the corrected pitch depth of bevel gears is based on the pitch radius.

* * *

STANDARDIZATION OF FIRE-HOSE COUPLINGS AND THREADS

The importance of the standardization of fire-hose coupling threads is easily appreciated. In the past, there have been various so-called standards, many of which have been used only locally in certain large cities or in certain parts of the country. It has always been difficult for the makers of threading tools to provide exactly what has been required unless an actual sample of the hose coupling has been provided. A review of the effort to standardize hose-coupling threads is given in the August number of *Mechanical Engineering*. It is pointed out that failure to recognize the importance of standards in this instance has resulted in enormous fire losses due to lack of uniformity in fire-hose couplings.

The first real movement for standardization may be said to date back to the great Boston fire of 1872. Following this conflagration several of the nearby cities, profiting by the experience, adopted the Roxbury thread coupling which was the Boston standard at that time. Later, New York City adopted a thread which became the local standard through general adoption by most of the New Jersey and New York state municipalities within a radius of from fifty to seventy-five miles. Local standards have been adopted in a number of places which has given a feeling of security and complacency. Experience has shown, however, that such an attitude is not entirely justified because of the fact that outlying towns are little better off than if there were no standards at all.

The first organized effort toward the adoption of a universal standard thread was made by the International Association of Fire Engineers during the period 1873-1883. It was not, however, until a Committee on Hose Couplings and Hydrant Fittings of the National Fire Protection Association was appointed in 1905 that the work was effectively started. Through the efforts of this committee the couplings known as the National Standard promptly received unqualified approval and adoption by all of the leading organizations concerned with fire protection. Coincidentally, the American Society of Mechanical Engineers appointed a sub-committee on fire protection whose report describes the methods by means of which the standards were adopted, the specifications for hose couplings, and the methods for converting non-standard couplings.

In December, 1919, an illustrated pamphlet, "Standardization for Fire Hose Couplings and Fittings," containing an extended treatment of the subject of this standardization, and a complete description of the resizing or standardization tools, was issued by the National Board of Fire Underwriters of New York City. Upward of 12,000 copies of this pamphlet have been distributed. This pamphlet, copies of which are still available, contains a description of a set of tools devised for the purpose of re-forming to standard size, and shows threads which are slightly different from standard.

There are about 8000 cities or towns in the United States and Canada that have fire-hose fittings in service. Statistics show that 15 per cent of them have National Standard thread couplings; 70 per cent have couplings that may be resized and made standard; and the remaining 15 per cent are either using couplings which have six threads to the inch or one of the various types of snap or clutch couplings.

The American Society of Mechanical Engineers has supported this movement from its inception and, as a body, is much interested in the recent strides toward its general adoption. Members who reside in localities where standardization movements have not already been initiated, are urged to take upon themselves the matter of arousing their respective communities to the importance of the subject.

* * *

ANNUAL MEETING OF A. S. M. E.

From the plans at present in process of preparation for the annual meeting of the American Society of Mechanical Engineers to be held in New York City, December 7-10, it may be judged that the meeting will be one of the most successful in the history of the society. The keynote session will deal with transportation, and prominent men in the railroad and water transportation fields will deal with important phases of this subject. Engineers engaged in the motor truck industry as well as those versed in the solution of terminal problems will also be heard. Six of the newly formed professional sections are making plans to hold separate sessions. These are the sections on fuels, management, machine shop, power, railroads, and textiles.

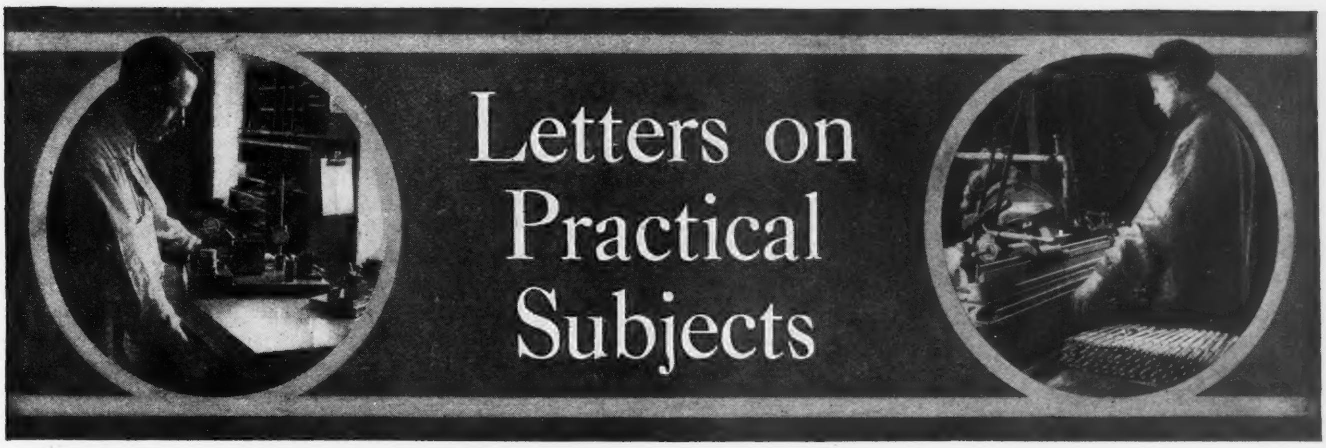
The need for better engineering in the woodworking field has long been recognized, and a sub-committee has been appointed by the committee on meetings and programs to arrange for a session on this subject for the annual meeting. The interest in appraisal and valuation displayed at the two previous meetings of the society has prompted the continuance of the consideration of this subject at the coming meeting. A number of papers that do not fall under any of the previous sub-divisions have also been received by the society, and the best of these will be presented at the general sessions of the society.

* * *

SMALLEST MOTOR IN THE WORLD EXHIBITED AT FOUNDRY CONVENTION

As far as is known, the smallest motor in the world, made by Ivan T. Nedland, Hillsboro, N. D., will be exhibited at the Foundrymen's Convention in Columbus, Ohio, October 4-9. It will be shown in the exhibit space of the Pangborn Corporation, Hagerstown, Md. The length of the motor over-all is 19/64 inch, the height is 11/64 inch, and it weighs complete about 5½ grains. A small flashlight battery is used for supplying it with current.

The commutator has four segments made of gold, each segment being insulated from the others with mica. Fiber is used as insulation between commutator and shaft and between the end pieces and the commutator. The commutator is built up in the same way as those of larger machines, no glue or cement having been used in its construction. The diameter of the commutator is 0.045 inch. The commutator is mounted on a steel shaft, 0.009 inch in diameter. The armature has four poles and is wound with No. 40 silk-covered wire. The diameter of the armature is 0.090 inch. The weight of the shaft, commutator and armature wound complete is 1¼ grains. The motor has two field coils between the armature and yoke. The brushes are made of silver and are 0.012 inch in diameter. The springs for the brushes are 0.004 inch in diameter.



GASKET-CUTTING ATTACHMENT FOR DRILLING MACHINE

A device suitable for mounting on a drilling machine for cutting rubber or fiber gaskets is shown in the illustration. The principal parts are the holder *A*, the cross-bar *B*, the cutter-holders *C* and *D*, and the cutters *E* and *F*. The two cutters are free to revolve on their axes. The shank of holder *A* is tapered to suit the socket in the end of the drilling machine spindle to which the device is attached when in use. When a gasket is to be cut, the holder *A* is secured in the drilling machine spindle, and the cutter-holders *C* and *D* are adjusted along the cross-bar until the cutter *F* is a distance from the center of holder *A* equal to the radius of the size of gasket to be cut, and the distance from cutter *E* to the center of the holder is equal to the radius of the gasket hole. The cutter-holders are then clamped in these positions by means of the set-screws *L*.

The drilling machine head is next lowered until the cutters rest upon the material from which the gasket is to be produced. At this time the pointed end of bolt *G* has entered the material until a certain amount of pressure is exerted on the material by the bearing plate *H* and the coil spring *I*, which is placed between the bearing plate and collar *J*. Then when the machine is started, the device revolves with the spindle and the cutters rotate in circular paths of the same dimensions as the gasket to be cut. The pressure exerted upon the material by plate *H* and spring *I* prevents it from turning during the operation. The cutting of the gasket is accomplished by gradually lowering the drilling machine spindle until the cutters have worked their way through the material.

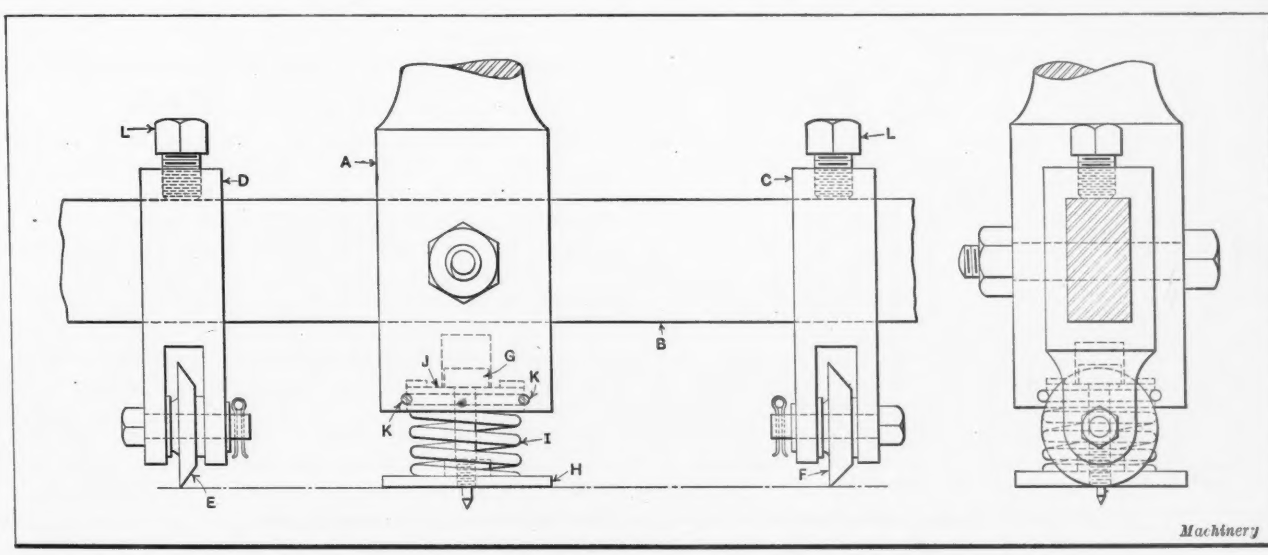
The cutters *F* and *E* should always be used in the same relative positions shown in the illustration, for cutting the periphery of a gasket and the hole, as otherwise the angular side of the cutters will mar the gasket surfaces. Bolt *G*, bearing plate *H*, and spring *I* are secured to holder *A* by means of collar *J* which fits into a recess in the lower end of the holder. The collar is secured in the holder by two pins *K* which engage a groove running around the collar. It is obvious that the size of the largest gasket that can be cut by means of the attachment depends upon the length of the cross-bar *B*. In the device illustrated, this length was 23 inches, and gaskets ranging from 2½ to 22 inches in diameter could readily be produced.

Chicago, Ill. H. A. PEARSON

DIES FOR BRASS CURTAIN POLE KNOBS

Several seemingly difficult punch press operations in the manufacture of curtain pole knobs or ends are readily performed on machines equipped with the punches and dies to be described in the following. These knobs are produced from brass blanks 0.026 inch thick and 1 9/16 inches in diameter. The first operation on the shell is performed on a press provided with the combination blanking and drawing die illustrated in Fig. 1, and consists of cutting the blank to the proper size and then drawing it to the shape and dimensions shown in the upper right-hand part of the illustration. The drawing of the shell to this extent in only one operation is helped materially by having the top ball-shaped.

The illustration shows the relation of punch *A* to the die at the end of the downward stroke of the press ram. Prior to the descent of the punch, the blank-holder *B* is raised by means of three pins *C* until the upper surface of the blank-holder coincides with the cutting edge of the blanking die *D*. Pins *C* are actuated by a rubber buffer located beneath the



Drilling Machine Attachment for cutting the Periphery and Hole of Rubber and Fiber Gaskets

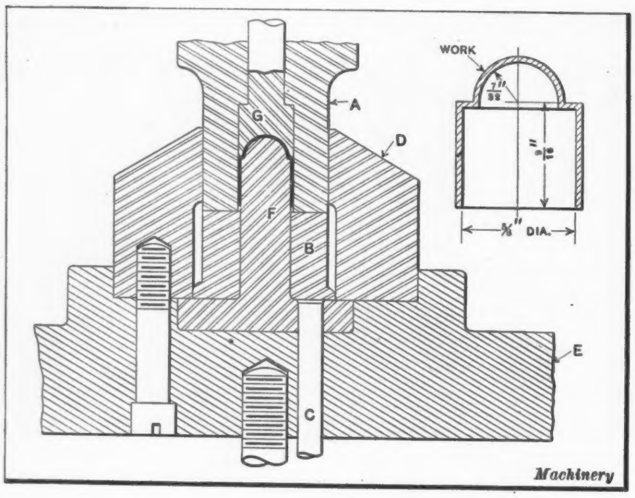


Fig. 1. Combination Blanking and Drawing Punch and Die which produce the Work as shown in One Operation

die-block E. Thus, when the punch descends after the brass stock has been laid across the top of the blanking die, the blank is cut as the punch enters the die, and is at the same time held firmly between the faces of the punch and the blank-holder. The latter condition prevents the formation of wrinkles when the blank is drawn upon the drawing die F, which occurs as the punch and the blank-holder continue to descend. The shoulder on the upper end of the shell is produced near the end of the stroke by the knock-out G in punch A. The shell is ejected from the die by the blank-holder as the latter is raised by pins C when the punch is withdrawn. In case the shell remains in the punch, it is removed by the knock-out G previously referred to.

The next two operations form the neck on the open end and complete the punch press work on the shell. These operations are performed on a machine having two plungers. The punch shown at A in Fig. 2 is attached to the end of one plunger, the punch shown at B in the same illustration being attached to the end of the other plunger. Only one die is provided on the machine, although one is shown under each punch in the illustration, arrangements being made so that this die can be swung under the second punch after the neck of the shell has been partially formed by the first. As the edge of the open end of the shell is quite regular after the preceding operation, no trimming is necessary on this end preparatory to these final forming operations.

The die is first placed in position beneath the punch shown at A, after which the shell is seated in the die part C, by means of the ball-shaped end and the shoulder on this end. Then when punch D descends, spring pin E enters the shell and exerts pressure on the ball-shaped end. As the punch continues to descend, the open end of the shell is closed

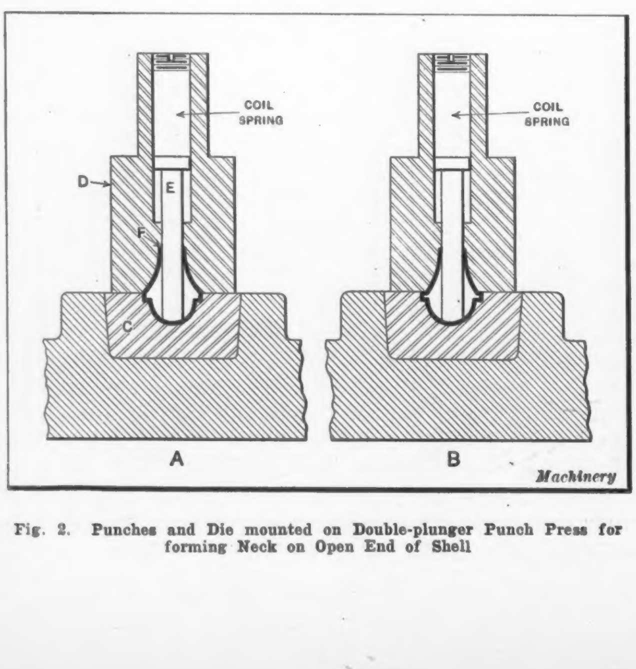


Fig. 2. Punches and Die mounted on Double-plunger Punch Press for forming Neck on Open End of Shell

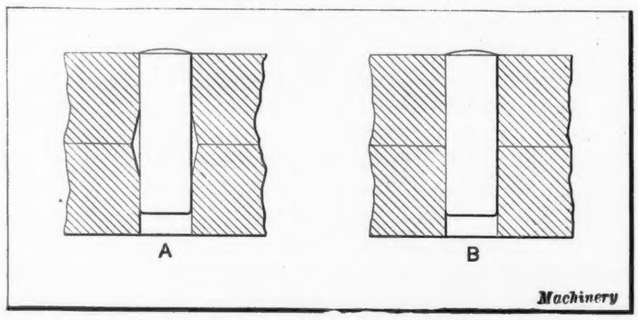
to the contour of the opening in the punch until the edge of the metal reaches shoulder F, the spring pin E causing the hole to be made to the proper size. The shell is ejected from the punch on the return stroke by the spring pin, as this pin is momentarily kept from rising with the punch l the coil spring placed above it.

The next step is to swing the die and shell beneath the punch shown at B. In the operation performed by this punch, the diameter of the large portion of the neck is reduced a trifle, so that a shoulder is formed on this side. The operation of this punch is similar to that of the punch shown at A. In the design of punches and dies of the type just described, care must be taken to see that the shoulder in the punch which the edge of the shell touches at the end of the operation, is located properly, and that the pin which regulates the size of the hole is of the correct diameter.

Toledo, Ohio J. BINGHAM

INCORRECT AND CORRECT DOWELING

When dowels are used to hold parts of tools or gages in alignment, care should be taken in reaming and lapping the dowel holes to see that they do not become bell-mouthed or tapered. If attention is not given to this point, a condition such as shown exaggerated at A in the illustration may be the result. Although this dowel fits tightly at both ends, the fit is such that a knock received during rough usage may be sufficient to cause the dowel to become bent, and



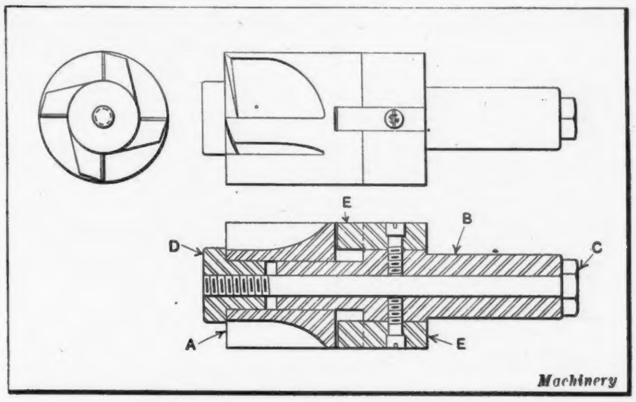
(A) Dowel-pin in Bell-mouthed Hole. (B) Dowel-pin in a Straight Hole

thus change the relation between the two members. It is evident that if a short dowel is driven into a hole of this nature, there will be considerable play between the two gage parts, which illustrates the fact that the dowels which fit tightly do not always prove satisfactory, especially when the fit does not extend throughout the length of the pin. The correct way to assemble two parts by means of dowels is to have the holes reamed or lapped straight, so that the dowel will have a bearing its entire length as shown at B. In this case, the tendency will be to shear the dowel, rather than to bend it. J. E. L.

COUNTERBORE WITH DETACHABLE CUTTER AND PILOT

The accompanying illustration shows a counterbore constructed in such a manner that the pilot and cutter can be removed from the shank to facilitate grinding the flutes of the cutter, without spoiling the pilot by having it come into contact with the grinding wheel. The latter is a common occurrence on tools of this kind, which are so designed that the pilot cannot be detached from the cutter for the grinding operation. Another advantage of this counterbore is the fact that a new cutter can be used with the old parts when the existing one must be discarded on account of wear. This obviously results in a great saving of labor and material.

It will be seen that cutter A is mounted on one end of the shank B, which has a hole running the entire length through the center to accommodate bolt C. This bolt is employed to secure the threaded pilot D to the unit. It is apparent that the shoulder on the pilot holds the cutter in place. The cutter is driven by two keys E which are fitted



Counterbore so designed that the Cutter can be removed for Regrinding or Replacement

in grooves on the enlarged portion of the shank and held to the shank by means of fillister-head machine screws. These keys extend into the groove milled across the adjacent end of the cutter, and thus cause its rotation with the shank. A small amount of end clearance is allowed between the keys and the cutter. Besides the advantages previously mentioned, cutters of various diameters can be used in conjunction with the other parts, the only requirement being that the hole, length, and key groove on the cutter, must be of the proper dimensions. C. D.

INCREASING THREAD DIAMETER TO ALLOW FOR ERROR IN LEAD

It sometimes happens that a screw and nut will not go together, even though the outside, pitch, and root diameters are within the required limits of accuracy, because the lead of the nut does not correspond with the lead of the screw. It is therefore necessary in some cases to increase the size of the nut or to decrease the size of the screw to compensate for the error in lead, so that the two parts can be screwed together. The accompanying diagram illustrates a simple method of calculating the amount that the diameter of a nut must be increased to compensate for a known error in lead. It is required to find the dimension AC which is one-half the amount that the diameter of the nut must be increased over that of the screw in order to permit the two parts to be screwed together when there is an error in the lead of the nut thread of 0.001 inch per inch of thread. In the triangle ABC, side $CB = 0.0005$ inch and angle $CAB = 30$ degrees.

Therefore

$$AC = CB \times \cot CAB$$

$$AC = 0.0005 \times 1.7320 = 0.000866 \text{ inch}$$

As this value is for one side only, the amount which the diameter of the nut must be increased is $2 \times 0.000866 =$

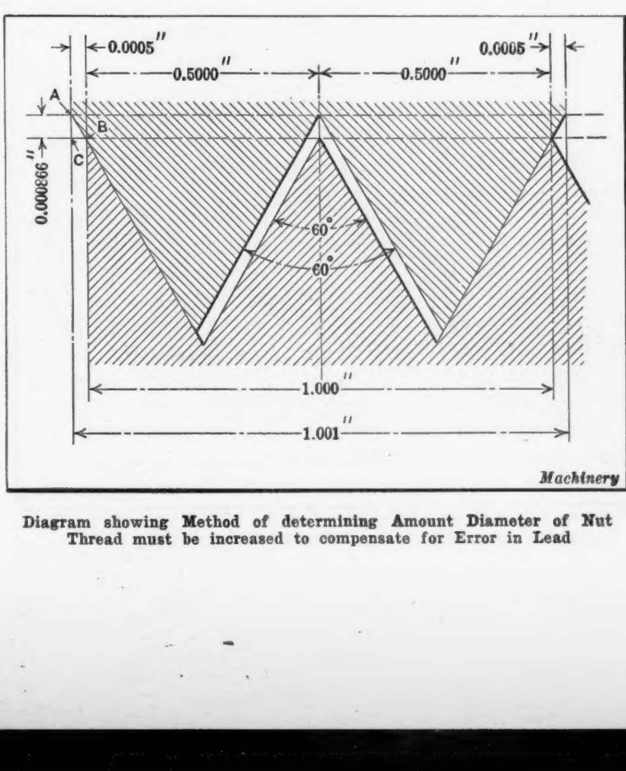


Diagram showing Method of determining Amount Diameter of Nut Thread must be increased to compensate for Error in Lead

0.001732 inch. Since the only quantities used in this solution are the differences in lead of plus or minus 0.001 inch and the thread angle of 30 degrees, it follows that the quantity 0.001732 may be employed as a constant. For instance if the error in lead should be 0.002 inch instead of 0.001 inch, the dimension AC would equal 2×0.000866, and the amount which the diameter of the nut thread must be increased would be 4×0.000866. B. S.

PATTERN FOR MOLDING SHEAVES

Many patternmakers are of the opinion that a two-part pattern having the parting line at the center, and intended for use in preparing the mold in green sand without the use of cores, is the most suitable when casting iron rope sheaves. The reason for this belief may be due to the fact that they were so taught when apprentices, and after becoming journeymen, continued to make such patterns in the manner stated, without receiving any criticisms pertaining to the design from foundrymen. However, this type of pattern is really inferior to a solid pattern which makes use

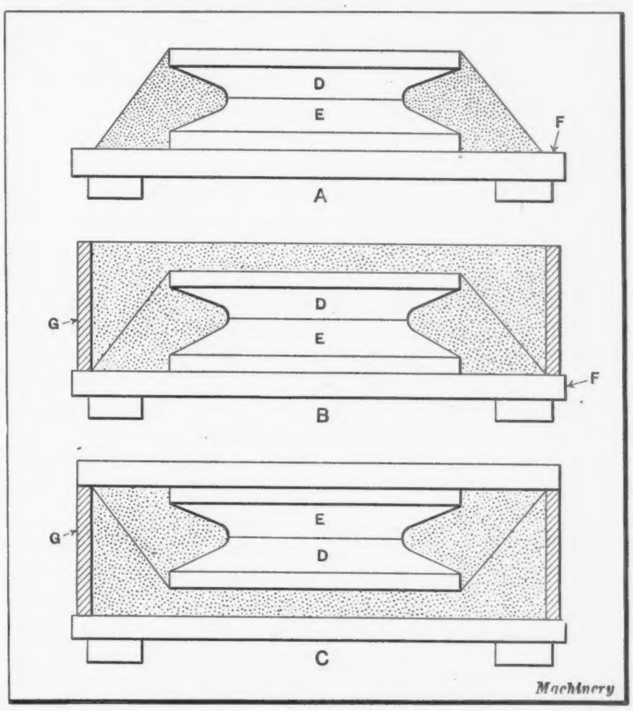


Fig. 1. Method of building Mold when the Pattern is of the Two-part Type which is Inferior to the Solid Type

of cores to form the ledge around the mold necessary to produce the groove on a sheave. In the following, a description will first be given of the manner in which molds were made by the use of a split pattern for casting twenty-five rope sheaves having an outside diameter of 6 inches. The manner in which a solid pattern could have been used in molding these sheaves will then be described. From these descriptions it will be seen that a better mold would have been made by the solid pattern and with far less labor than was required in making the mold from the split one.

The procedure followed in building the molds from the split pattern can be readily understood by referring to Fig. 1, a two-part flask being used. The first step in the molding operation is illustrated at A, the pattern halves D and E being first placed upon the molding board, after which sand was built around them as shown in order to form the ledge required in the mold for producing the groove on the sheave. The next step was to place the cope G of the flasks on the molding board, and then ram sand over the pattern and the sand molded in the first step, as at B. After this step was completed another molding board was placed on top of the cope and the entire mold turned over as shown at C. The drag was then placed on the cope and filled with sand, which was next rammed and struck off. The drag was then re-

moved and the pattern section E taken from the mold, after which the drag was replaced and again covered with the molding board. The mold was then again turned over so that the drag was underneath, the cope lifted, and the pattern half D removed. After this had been done, the cope was replaced and vents and a pouring hole made in the usual way, thus completing the mold. On account of the nature of this mold, it was impossible for it to be made in a large flask containing other molds, and so a 14-inch flask was used for this small job.

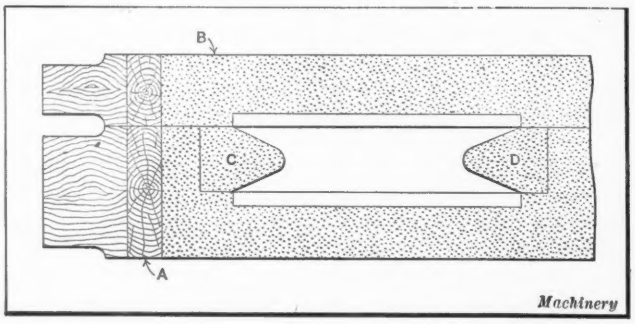


Fig. 2. Sheave Mold made by using a Solid Pattern and Cores

Fig. 2 shows the method followed in making a similar mold from a solid pattern. The drag A is first placed on the molding board, then partly filled with sand, and the pattern placed in position. Sand is next rammed around the pattern, after which the cope B is placed on the drag and filled with sand, which is also rammed down. The cope is then removed so that the pattern can be taken out, two cores C and D, each of which run half way around the mold, are placed in the impression formed by the core-prints on the pattern, and the cope is replaced. After vents and a pouring hole have been made, the mold is completed.

Some of the advantages of the solid pattern over the two-part type obtained in molding are that there is much less labor required in making the mold; the mold can be placed in a corner of a large flask containing other molds; and there is much less danger of the delicate ring of sand which forms the groove in the sheave being washed away when the molten metal is poured. Besides these advantages, a solid pattern can be made more quickly than a two-part pattern and can be used for years, whereas, the split pattern will soon become warped and worthless.

Kenosha, Wis. M. E. Duggan

THE TREACHEROUS SHARP CORNER

The writer has read with much interest the editorial in the August number calling attention to the treacherous sharp corner and mentioning how a machine designer had carelessly omitted the rounding of a corner in an important forging, thereby causing a serious accident. It certainly is surprising to an old-time designer that anyone who would overlook such an important matter should be permitted to work on so important a job and be honored by the name "designer." It does not seem likely that an experienced man who had had years of hard knocks and who had been thoroughly drilled in designing work and taught to avoid mistakes by his past observations would have neglected such a well-known and important rule. The writer believes that the reason for such mistakes and consequent accidents are due to the employment of incompetent men who are allowed too much liberty and freedom of play with their untrained ideas.

It is one thing to be technically aware of the rule for rounding corners; it is quite another thing to instinctively know and feel what the result would be if the rule were ignored. The same can be said of hundreds of other seemingly small but important points in connection with machine design. For this reason it would seem that the men who are young in the profession should be kept more in touch with experienced men until their work has been proved reliable by close observation.

In the past decade or so the clamor for young men to fill important positions has resulted in the discouragement of many of the older ones, and has thereby created a shortage of the highest available skill and knowledge. This is particularly true in the matter of machine design and other engineering work. Speed and quantity may be important, but they are not always prime essentials, especially not in those who are employed mainly to guide and direct operations, and when this fact is thoroughly recognized we will have come one step nearer to a true basis of economy, efficiency, and safety.

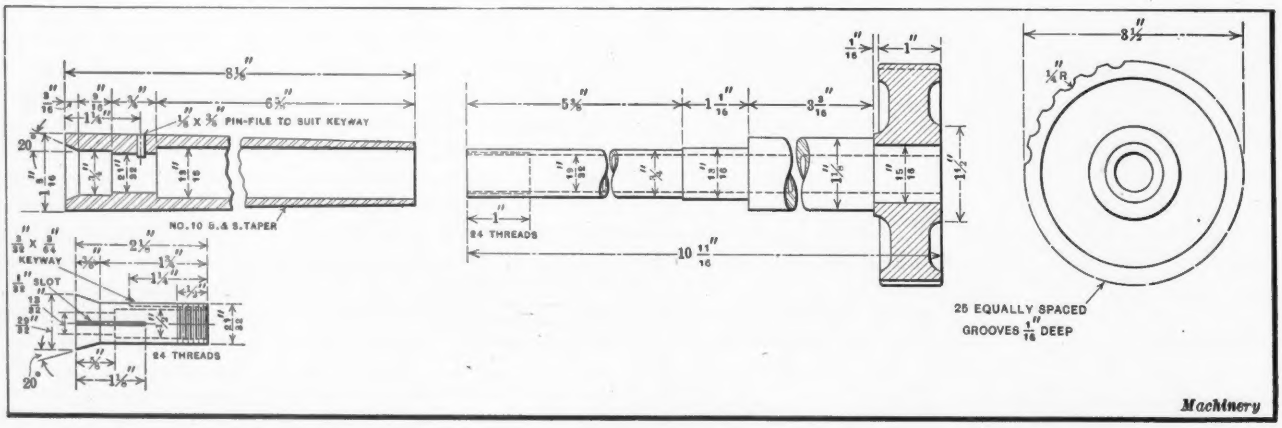
Chicago, Ill. William H. Kellogg

DRAW-IN CHUCK FOR MILLING MACHINES

The accompanying illustration shows an adaptation of the standard draw-in collet chuck, for use in holding small milling cutters in the spindle of a Brown & Sharpe universal milling machine. Standard type collets such as used on the Pratt & Whitney bench lathe were used. These collets fit into the sleeve, which has a No. 10 B. & S. taper to fit the machine spindle, and is provided with a 1/8- by 3/8-inch pin that engages a keyway in the collet. This arrangement makes a very handy device for use when small, straight-shank milling cutters are employed. The taper sleeve, threaded draw-in spindle, and collet are made from machine steel, and the handwheel from cast iron. The length of the threaded spindle that carries the handwheel should be such as to suit the length of the machine spindle.

Baltimore, Md. W. C. Steuart

Experiments made by the Bureau of Standards indicate that cold-rolling operations cause smaller stresses in the metal when rolled by a large number of light passes than when rolled by a smaller number of heavy ones.



Draw-in Collet Chuck for holding Small Straight-shank Milling Cutters on a Brown & Sharpe Universal Milling Machine

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, September 16

THE prospect of a lessened volume of business that showed itself some time back in the machine tool industry has been partly realized. The regular vacations that have been taken for the first time since the beginning of the war have also had their depressing influence, at any rate for the moment. At the same time manufacturers have a much clearer view of the road before them now that the excess profits tax of 60 per cent has been authorized. In the engineering trade a halt has been called to the stream of wage advances by the recent decision of the Industrial Court against a further increase, but other trades are getting ready for a renewed struggle for more money. Prices have reached figures that cause hesitancy in buying, and only through improved equipment and industrial organization can prices be brought down. As an instance, one of the leading motor vehicle manufacturers has reduced the price of its product 15 per cent by making full use of its war experience and the improved plant and methods now available. Some firms, particularly in the motor industry, have revised their production program as a result of cancellations. A slight fall in the price of steel is a welcome augury of a change toward more normal conditions.

Exports and Imports of Machine Tools

From the British point of view the continued improvement in the ratio of exported to imported machine tools is a welcome sign. Prior to the war Great Britain exported machine tools to the value of £260 for every £100 worth imported. At the beginning of the present year the exports were £50 per £100 of imports, but the ratio is now 75 to 100. Roughly, three times the value of drilling machines, planers, and presses was imported as compared with the value of those exported, whereas more than double the value of lathes and milling machines was imported.

The latest returns show that exports from Great Britain have increased considerably and reached a much higher figure than ever before. Imports, after averaging up fluctuations, tend to remain stationary, although the value per ton of imported tools remains at 40 to 50 per cent higher than the corresponding value of exported machines.

The British Engineering Standards Association has issued a report giving data to be recognized as standard for milling cutters and reamers—a matter long overdue. This country is increasing its export trade, American included, in such tools as are dealt with in the report, and it is therefore of equal interest to both sides as exporters to supply what is required and understood to be standard in the importing country. British-made milling cutters and reamers should be interchangeable with the American-made articles, and fortunately in such tools there is little divergence to be bridged.

Labor Conditions

In spite of several reports in circulation that large numbers of workmen in the engineering trades had been discharged, the official figures for the past months indicate that employment in these trades was good and showed little variation from the previous months. What unemployment exists seems to be confined mainly to the less skilled workers; shortage of fuel and materials is assigned as the main cause. Shortage of castings, which is still being felt in some districts, is another cause. Against this a considerable amount of over-time is reported as having been worked in some districts. The unemployment is stated to have caused men to become more careful of their jobs and to adopt a more serious attitude toward productive efficiency. No one, however, wishes to see unemployment made the price of improved efficiency and energy; but there is no gainsaying the fact that high wages, lessened hours of work, and the attitude against systems of payment by results will inevitably lead to reduced business which will, in turn, lead to unemployment. It is for labor to understand this, and equally so for those manufacturers who contribute to a lessened demand by expecting dividends or profits on a high prewar scale.

The Amalgamated Engineering Union came formally into existence about a month ago. Its membership is estimated at about 460,000, while its funds amount to £4,000,000. The eleven societies amalgamating include the most important trade unions in the engineering and allied trades.

Two serious labor troubles have crystallized during recent weeks, and negotiations between employers and men in the engineering trades have broken down, an immediate lockout being threatened. The difficulty has arisen over the power of the employer to appoint as foreman any man he may choose, while the Electrical Trade Union wishes to compel the appointment of union foremen over union men. The Engineering Employers' Federation, having accepted the challenge, a lock-out would result in one and a half million men being deprived of work, although the trade union concerned amounts to some ten thousand only, who are directly connected with engineering shops.

The threatened coal strike, ostensibly for higher wages, is undoubtedly part of a plan for a nationalization coup. The public are apt to meet the threat as a cry of wolf, but the Government is preparing as far as is possible for any emergency.

Industrial Developments and New Machine Tools

The largest plant devoted to the production of typewriters in this country is the Imperial Typewriter Co., Ltd., Leicester, and demands for its products have necessitated a threefold increase in its factory. The new buildings will have a floor space of 46,000 square feet. Wadkin & Co., also in Leicester, the well-known makers of all classes of woodworking machines, have also been compelled to erect a new factory on a site covering eight acres. John Hetherington & Sons, Ltd., Manchester, have arrangements in progress to double their output of machine tools, and particular attention is being given to railway wheel and axle turning lathes. J. W. Bradley Small Tools Co., Ltd., Leicester is developing a new plant for the extensive manufacture of twist drills.

A new production by the Lumsden Machine Tool Co., Newcastle-on-Tyne is a vertical-spindle grinder. The table has a working surface of 15 by 72 inches, and the heavy crossrail is supported on a planer-type box housing on one side and on a large-diameter vertical pillar on the other side. The latter carries the grinding wheel spindle bracket. The grinding wheel is built up of eight segmental blocks with clearances between each, and this construction enables very heavy cuts to be taken without fear of bursting. This machine tool is being placed on the market by Alfred Herbert, Ltd., Coventry.

The Olympia Exhibition

While the machine tool trade, the barometer of production, has naturally followed the general hesitancy in pur-

chasing that has set in in all trades, it is expected that the machine tool exhibition at Olympia will result in a sharp, if temporary, increase in sales. At the same time, the educational value of such an exhibition is great. Economy of operative labor is the keynote in the majority of the machines that were shown. In manufacturing machines, the stepped cone pulley has all but disappeared, and centralized control replaces the time-wasting scattered controls. The push-button method of controlling the heavier machines has made advances, and parallel steps have been made with shockless changes of speed and direction attained by electrical means.

It would be invidious to pick out any one branch of machine tool design as showing the greatest development, although gear-cutting machines showed a remarkable advance since the exhibition held prior to the war. During recent years the demand for machine tools of all kinds has been so great that British makers have been forced to import in large numbers certain lines of tools, and this has given rise to the impression that such particular machines could only be obtained from the United States; among these lines one of the most prominent is the horizontal milling machine. Without in any way belittling the progress made by America, it is certain that concurrently with the developments in America, there has been a development in design, essentially British, that is at least equal. The evidence available thus far leads one to believe that, while the industry has been working without cessation at a very high pressure for quite six years in fulfilling vital and immediate requirements, the future has not been forgotten. British manufacturers are moving, without exception, toward a definite objective, and considering the difficulties with which they have to contend, there is much upon which they are to be congratulated.

The production of gages in this country has now been established, the methods of manufacture and measurement being the direct product of the work of the National Physical Laboratory, Teddington, the British equivalent of the United States Bureau of Standards.

* * *

PEAT FOR GAS PRODUCERS

The U. S. Geological Survey calls attention to the use of peat in gas producers properly designed for this purpose. Peat will give a gas of as good quality as coal and in greater quantity. There are also valuable by-products which may be obtained when peat is used. It is believed that the gas producer will make possible the most effective utilization of peat fuel for generating power, because when peat is used in this manner, it does not need to be so carefully prepared or so thoroughly dried as when it is consumed directly under a steam boiler. This utilization of peat in gas producers opens up an enormous supply of fuel for power purposes in a great many parts of the world. Gas-producing plants using peat are now operated in England, Ireland, Germany, Sweden, and Italy. As far as is known, no gas-producing plants are operated with peat in the United States, although experiments have been made.

* * *

The California Industrial Accident Commission has handed down a ruling that should make workmen engaged in occupations where accidents are likely to happen careful to use the provided safeguards. A case came before the California Commission where an employe was not wearing protective goggles provided by his employer, and in refusing to wear goggles he acted in direct disobedience to posted orders requiring employes to use these safety devices. The man was injured, and the commission ruled that the employe's action in neglecting to wear the goggles was an act of serious and willful misconduct, and since the employer had enforced the rule by reprimanding employes for violations of it, the employe's accident compensation was reduced to one-half.

FOUNDRYMEN'S CONVENTION AND EXHIBITION

The program of the American Foundrymen's Association convention to be held in Columbus, Ohio, October 5 to 8 contains a great variety of papers to be read and technical sessions on the various fields that are of importance to the foundryman. On Tuesday, October 5, there will be a gray iron session in the morning, and a non-ferrous metal session in the afternoon. The latter session will be held jointly by the American Foundrymen's Association and the Metals Division of the American Institute of Mining Engineers. Simultaneously with this session there will also be a session on steel castings.

Wednesday, October 6, there will be a second non-ferrous metal practice session in the morning, held simultaneously with another steel casting session. In the afternoon of the same day, industrial relations will be discussed, and this session will be continued in the morning of October 7. There will also be a metallographic session of the metals division of the American Institute of Mining Engineers in the morning of October 7. Malleable iron will be discussed at the Friday morning session, October 8, and simultaneously with the session a general session will be held dealing with such subjects as foundry equipment; design of foundries; cleaning room methods; arc and fusion welding in the foundry; foundry illumination; molding sand; foundry cost accounting; molding machines; concrete molding floors; and similar subjects.

The business session will be held at 8 P. M. Thursday, October 7, at which the annual address of the president C. S. Koch of the Fort Pitt Steel Foundry Co., McKeesport, Pa., will be delivered.

In connection with the convention, there will be an extensive exhibition of machine shop and foundry equipment during the whole week of October 4 to 9. The exhibition is expected to be the largest ever held in connection with the foundrymen's convention. There will be much of interest to men in the machine building field in the exhibits. Many of the machine tools as well as the foundry equipment exhibited will be operated during the exhibition week.

* * *

CONVENTION OF AMERICAN SOCIETY FOR STEEL TREATING

From September 14 to 18, inclusive, the American Society for Steel Treating held its second annual convention in the Commercial Museum, Philadelphia, Pa. This society represents the amalgamation of the American Steel Treater's Society of Chicago, Ill., and the Steel Treating Research Society, of Detroit, Mich. For the time being the headquarters of the amalgamated organization will be at 208 N. Wabash Ave., Chicago, Ill. Morning, afternoon, and evening meetings were held on the 14th, 15th, and 16th at which there were read papers dealing with a number of phases of advanced practice in heat-treating. Arrangements were made for those in attendance at the convention to visit important Philadelphia manufacturing plants on Friday, the 17th. In the morning, the factories which were open for this purpose were those of the Leeds & Northrup Co., makers of pyrometers, electric furnaces, and electrical measuring instruments; Edward G. Budd Mfg. Co., makers of automobile bodies, steel stampings, etc.; and Hess-Bright Mfg. Co., makers of annular ball bearings. In the afternoon, the plants open for inspection were the League Island Navy Yard, Hog Island Ship Yard, and the Midvale Steel & Ordnance plant. Delegates and visitors to the convention were also given an opportunity to see many of the latest forms of equipment used in heat-treatment, which were exhibited by manufacturers. One hundred and sixteen firms had their products on exhibition. The exhibits were kept on view on Saturday, the 18th, but no meetings were held on that day.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Norton Self-contained Cylindrical Grinding Machine

In the past the highest table speed ever attempted on cylindrical grinding machines has been twelve feet per minute. The shock and noise at the point of reversal has made it impracticable to increase the table speeds beyond this limit. In the machine here described, a radical departure has been made in the matter of table speed. By the use of a patented reversing mechanism invented by Charles H. Norton, it has been found practicable to bring the table speed up to as high as thirty-six feet per minute; yet the reversal is practically noiseless, and the machine operates more quietly than machines of the past having only one-third or one-fourth the table speed.

A CYLINDRICAL grinding machine embodying in its design several radical departures from past practice has been brought out by the Norton Co., Worcester, Mass., the machine being known as a 10- by 72-inch Type B Norton cylindrical grinding machine; 36-, 48-, and 60-inch sizes will also be manufactured. The observer in examining this machine will doubtless first give his attention to the fact that the machine is entirely self-contained; being provided with a motor drive, there are no overhead belts whatever. The most noteworthy feature of the machine, however, is not seen until the machine is observed while in operation; this feature is the speed at which the table travels. In the past, the speed of cylindrical grinding machine tables was limited to a maximum of twelve feet per minute by the shock and noise incident to reversal at higher speeds. The present machine has a minimum operating table speed of ten feet per minute, which is close to the maximum in past designs, and it has a maximum table speed of thirty-six feet per minute, which is three times the speed attempted in past practice. The increase in production possible by such a decided increase in table speed is evident.

As mentioned, the drive is by means of an electric motor mounted at the rear of the machine, as clearly shown in Figs. 2 and 4. There are only two belts on the machine, neither of which is visible when the machine is in opera-

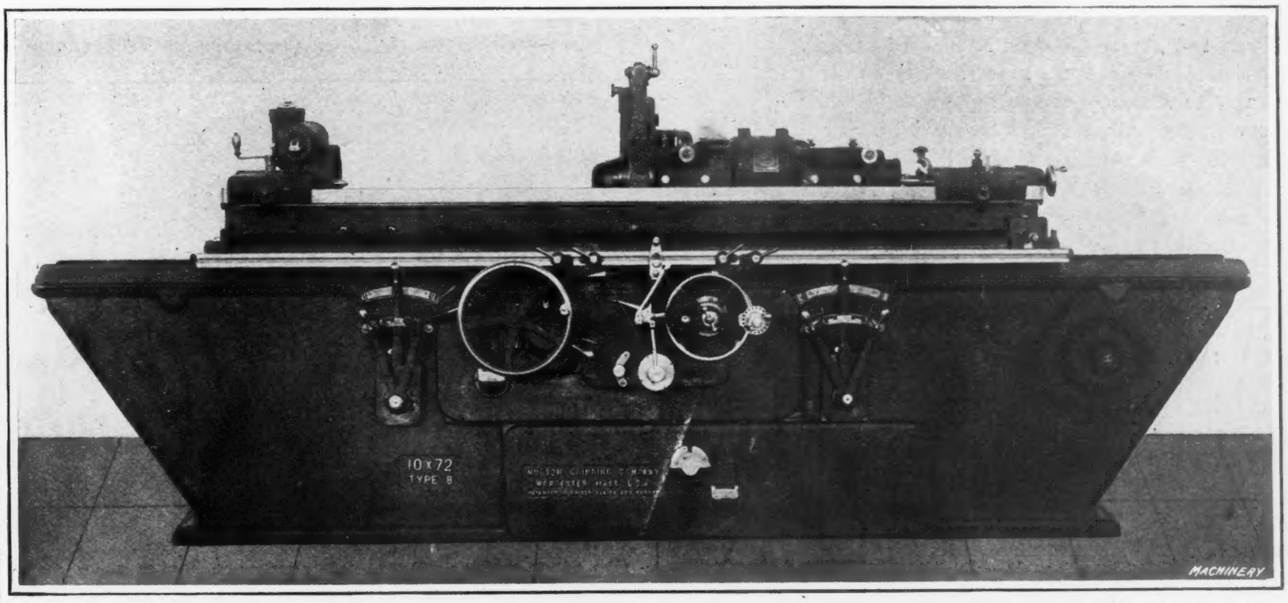


Fig. 1. Self-contained Cylindrical Grinding Machine built by the Norton Co., Worcester, Mass.

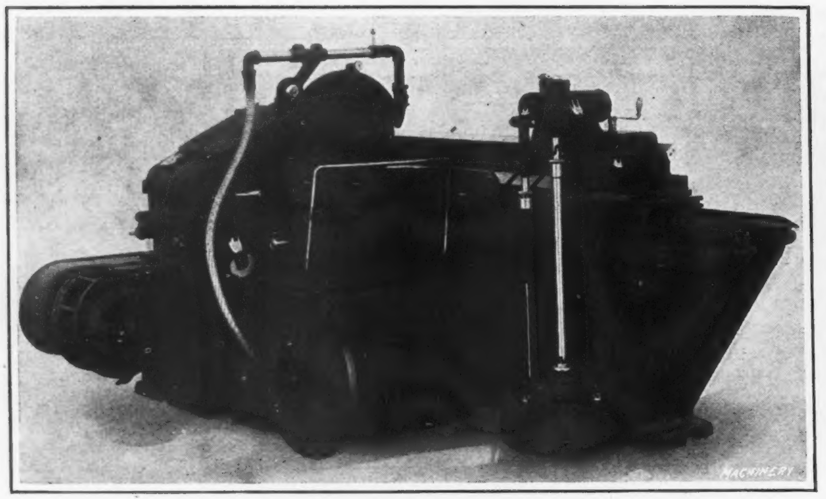


Fig. 2. Rear View of Grinding Machine, showing Arrangement of Settling Tank

tion; all other power transmission is by means of gears or chain drives.

The wheel-head or wheel-slide shown in Fig. 3 is provided with a novel and unique bearing box design. The box is made in three parts. One of these parts, made from bronze, is in the form of a half-circle, so located that the entire pressure of the spindle is taken by it. The other two parts are babbitted and are pressed against the spindle, one on the horizontal center line and the other on the top vertical center line. These babbitted boxes are adjusted by means of the screws on the top and side of the boxes, as indicated. The adjustment is by means of thumb-nuts, and the arrangement is such that the operator cannot cause the spindle to stick when adjusting the bearings, as he simply screws down the adjusting screws by thumb and finger until he cannot turn them any more. This adjustment may be made at any time while the spindle is running. The end thrust is taken by a thrust bearing, which is also adjusted by a thumb-screw as shown at the extreme right of Fig. 3. The oil is supplied to the spindle bearings by means of force feed, and the circulating oil is visible through two glasses facing the operator, as indicated in the upper part of the bearings. The wheel-slide contains the chain-driven pump and oil reservoir for oiling the wheel-spindle bearings and the end-thrust bearing.

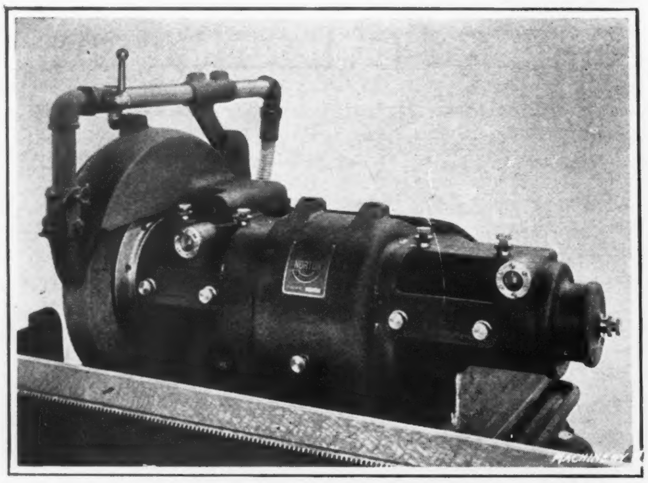


Fig. 3. Detail View of Wheel-head, showing Adjustment Screws for Bearing Boxes

The wheel-spindle is driven by a belt from the main shaft in the base of the machine. The driving pulley on the wheel shaft is placed between the two spindle boxes, and the belt pull is always downward. An idler is provided for taking up the slack of the belt. It is possible to transmit a greater amount of power to the wheel-spindle by this design than in former drives, because with the belt pull downward, the wheel-slide is always pressed on the base. The wheels used in connection with this machine are of the large-hole type. The largest grinding wheel allowable is 18 inches in diameter by 6 inches wide. The standard size wheel is 18 inches in diameter by 2½ inches wide. The speed of the spindle is 1300 revolutions per minute. The wheels are so mounted upon the wheel sleeve that the wheel practically passes over the end of the spindle bearing. A single spindle speed is used, because with the large-hole wheels of a size such as required for this machine the difference between the speed required for the new wheel and one partly worn is so slight that there is no need for a variety of spindle speeds. The speed has been fixed to be correct for the mean diameter of the size of the wheel.

An interesting feature is also introduced for the balancing of these wheels. Instead of drilling a hole in the wheel and filling it with lead for the purpose of balancing, there is a small groove on both sides between the wheel sleeve and the inside of the wheel rim. Into this groove is dropped a lead weight mounted on a spring wire. This weight can be slid around in the groove to any point where it is required for balancing, and the spring wire then grips against the inside of the wheel and holds the weight tightly in the position in which it has been placed. The wheel feed mechanism permits of automatic feed, ranging from 0.00025 to 0.0035 inch diameter reduction at each reversal of the table, with steps of 0.00025 inch, the amount represented by each tooth in the index feed gear.

The table speeds used on this machine are made possible by a new patented reversing mechanism, by means of which, at the end of the table travel, the speed is slowed down gradually until the table reverses, at which point the speed is again gradually increased until the full table speed has been reached. This gradual slowing and accelerating of the table speed makes it possible to reverse without shock or noise. At the same time, the mechanism is so arranged that the reversal is controlled by positive clutches.

The headstock, shown in detail in Fig. 5, is driven through a telescoping shaft provided with universal joints at the ends, as more clearly shown in Fig. 2. The drive is through spiral and worm gearing, all the driving gears being entirely enclosed and running in oil. The work revolution may be started or stopped simultaneously with the table, or independent of

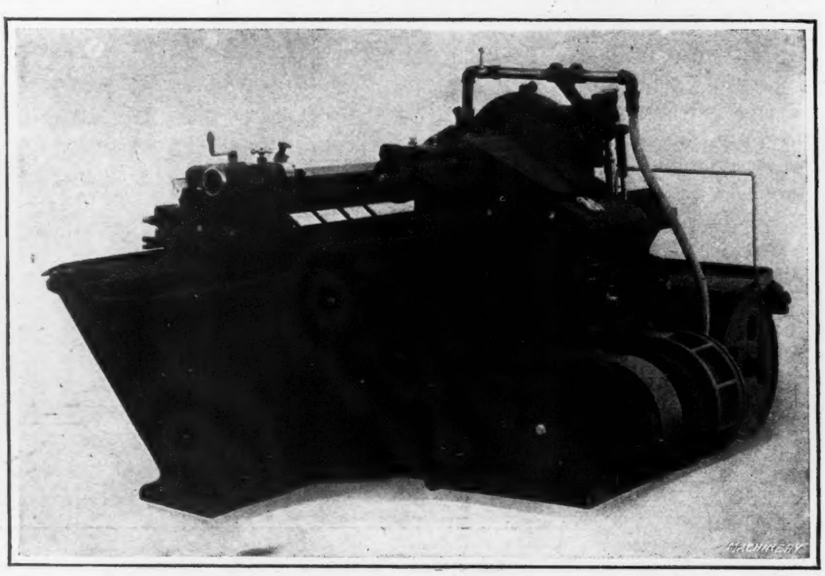


Fig. 4. Rear View of Norton Cylindrical Grinding Machine, showing Electric Motor Drive

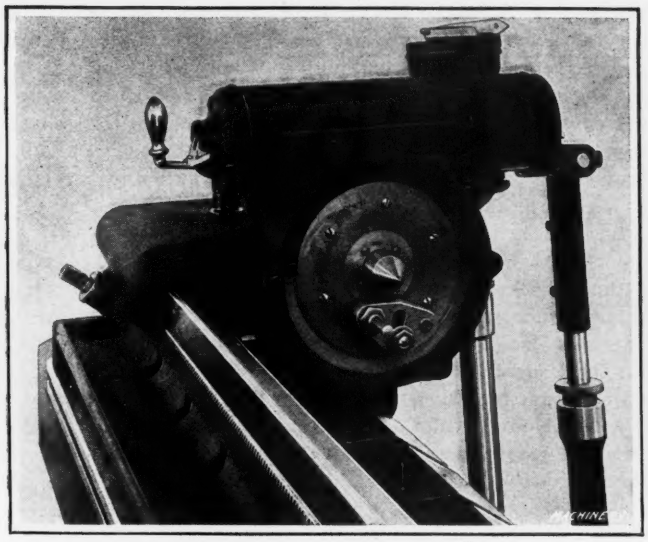


Fig. 5. Headstock of Norton Cylindrical Grinding Machine

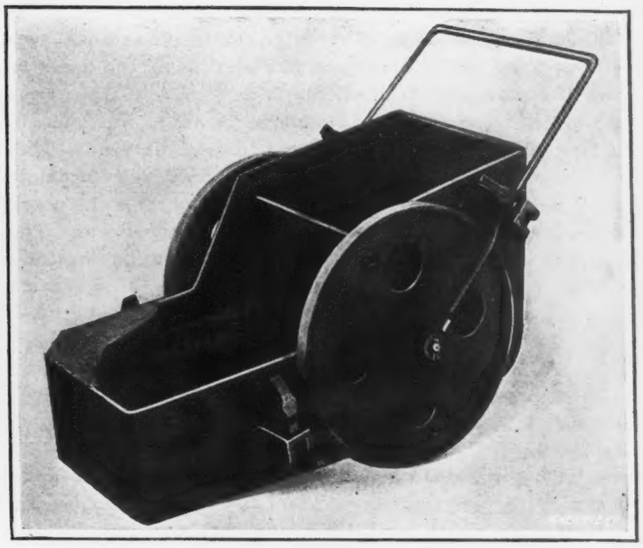


Fig. 6. Settling Tank removed from Machine for cleaning

the table movement, as desired. The footstock is of the combined screw and lever type construction.

The wheel feed involves several new features. A quick-acting hand cross-traverse for the wheel-slide and a micrometer adjustment for sizing work are provided. The pawl action for the in-feed is of an improved construction, and is operated either at each end of the table stroke or when the table is not in motion, as in case a direct in-cut is desired. The change from one condition to the other may be made by a simple movement of a lever.

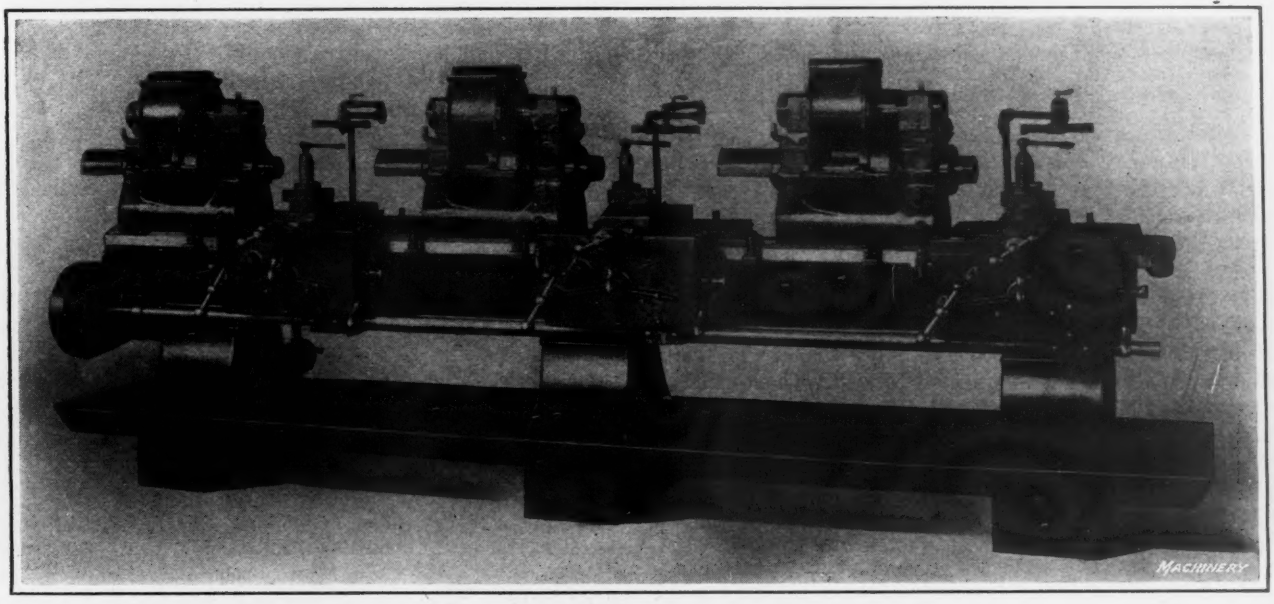
Special attention has been paid, in the designing of the machine, to the lubrication of bearings. With the exception of a few places where it is not essential that the oiling be frequent, all the bearings are automatically oiled. There are also forty-seven ball bearings throughout the machine, all of which are enclosed in oil baths.

A unique feature of the machine to which special attention should be called is the arrangement of the settling tank. This tank is shown in Fig. 2 in place on the machine, and is mounted on wheels. The pump tank and the settling tank are integral parts. The pump is arranged to swivel on its driving shaft, so that it can be swung out of the tank and the tank removed for dumping the settled dirt and grit. While one tank is removed, a duplicate tank can be filled with clean compound and rolled into place; hence, the machine need not be out of operation for more than from three to five minutes for the purpose of changing tanks for cleaning. An entire battery of machines will need only one extra settling tank in order to keep the whole battery going at all times. Fig. 6 shows the tank as removed with its handle in position for pushing it along the floor. In Fig. 2, where the tank is shown in place on the machine, the handle is swung upward and locked in a position where it forms a hand-rail for the small platform provided for the operator to stand upon when changing wheels.

The motor supplied with this machine is a 15-horsepower constant-speed motor, making 1200 revolutions per minute. The width of the main driving belt is 6 inches. The approximate net weight of the machine, complete with motor, is 11,000 pounds, and the approximate floor space is 16 feet 3 inches by 7 feet 2 inches.

SENECA FALLS MULTI-HEAD LATHE

With a view to economizing the time of men employed to operate lathes engaged upon the performance of repetition production work, through finding employment for the man while a tool that he has brought into contact with the work is engaged upon its operation, the Seneca Falls Mfg. Co., 381 Fall St., Seneca Falls, N. Y., has developed a multi-head lathe which is here illustrated and described. Instead of allowing the operator to remain idle while the tool is taking its cut, it is possible for him to keep several heads going,



Multi-head Lathe built by the Seneca Falls Mfg. Co.

as it is only necessary to remove the finished piece of work, put another one in place between the centers and pull a lever that starts the feed. After this has been done, the operator proceeds to the next head on the lathe. On one typical job handled on these machines, a single operator was able to run two triple-head lathes, that is, a total of six heads. This job consisted of turning pieces of tubing approximately 6 9/16 inches in diameter by 6 inches long, and the work was held on mechanically operated expanding mandrels. The depth of cut was 3/32 inch, and on this operation the total machining time was approximately three minutes for six pieces of work. The cutting tools were made of stellite.

Method of Operating the Machine

After a piece of work has been set on the lathe mandrel, the lever at the right-hand end of the apron is lifted, which provides for first advancing the cross-slide and tool to the work, where it is held in place by a latch. The same lever movement that engages this latch also engages clutches for the longitudinal feed, and when the carriage has traveled through the required distance, a lever at the left-hand end of the carriage engages a cam mounted on the vee of the bed, which throws out the latch that holds the tool in place and allows the cross-slide to drop back out of the way, so that the work will not be scored while the tool is moving back to its starting position.

In addition to returning the cross-slide to its initial position, a quick return clutch is engaged, that runs the apron back to its starting point at high speed. At this point, the carriage is stopped by having the lever at the right-hand end of the apron come into contact with a second cam mounted on the vee of the machine bed. The positions of these two cams are adjustable and they may be set to meet the requirements of various work. By this method it is not necessary for the operator to stop the carriage or to bother about returning it to the starting position; and this not only eliminates some physical labor but also relieves him from the necessity of carefully watching the progress of the cut. As a result, the operator is free to attend to a number of these lathe heads.

Features of Construction

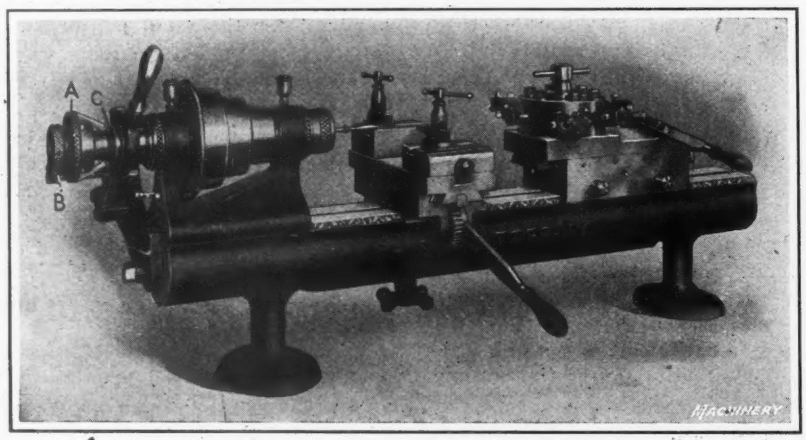
The headstock carries a casehardened spindle, the front bearing of which is 3¼ inches in diameter by 5½ inches long, while the rear bearing is 2¾ inches in diameter by 4½ inches long. Both bearings are ring-oiled. Upon the spindle there is mounted a large gear which is driven from a pinion shaft carried in the upper bearings of the headstock. This shaft runs in liberally proportioned bearings which are also ring-oiled, and it receives power from a driving pulley measuring 6 inches face width by 10½ inches in diameter. The two gears run in a bath of oil and suitable provision has been made for preventing the leakage of oil from this gear-case. The carriage is carefully gibbed to the bed and the apron is of the so-called "double-wall" type of construction, with the clutches and practically all gears, pinions, etc., made of alloy steel and heat-treated. The rack is made of tool steel and securely fastened to the bed.

Power for operating the feed mechanism is taken directly from the countershaft to a pulley at the left-hand end of the machine and by means of a silent chain is transmitted to the feed shaft that is shown at the front of the bed. Both the carriages and aprons are so arranged that should any one of them get out of commission, it may be removed without incapacitating the remainder of the machine. A chain-driven oil-pump is mounted at the rear of the lathe and supplies an abundance of lubricant to the tools. Suitable provision is made for collecting the used fluid and carrying it back into the pan for subsequent circulation.

In addition to the machine here illustrated and described, the Seneca Falls Mfg. Co. also makes a cone-driven type without back-gears, which is adapted for use in turning brass, bronze, or steel where only a light cut is required. This machine is of substantially the same construction that has been described, with the exception of the headstock, which is not furnished with back-gears. Both machines are built along the lines of a 16-inch lathe and swing 11¼ inches over the carriage and 18½ inches over the bed. Smaller sizes can be built to special order.

POTTER BENCH HAND SCREW MACHINE

The S. A. Potter Tool & Machine Co., 77 E. 130th St., New York City, is now building its standard precision bench lathe equipped as a manufacturing tool. This machine consists of the regular lathe bed and headstock and special equipment including an improved lever chuck-closer, a turret fixture and a double cross-slide. The chuck-closer is substituted for the regular lathe draw-in sleeve, so that the work may be chucked or released while the machine is in operation. It will be seen that the lever chuck-closing device consists of two latches or fingers carried in a retaining collar. These fingers bear against an adjustable knurled jam nut *A* on the end of the draw-in sleeve, and they are operated by a clutch collar *C*, the tapered end of which is engaged by the extremities of the two fingers. By moving the hand-lever to the left, the draw-in sleeve and spring collet are forced toward the rear of the headstock, which results in tightening the work. When the operating handle is moved in the opposite direction, tension on the work is released, but the chuck is not actually opened without an additional movement of the handle, which brings the small roller *B* against the side of the jam nut, resulting in opening the chuck and releasing the work.



Bench Size of Hand Screw Machine manufactured by S. A. Potter Tool & Machine Co., showing Chuck Closer, Double Cross-slide, and Turret Fixture

The attachment by means of which this lathe is converted into a turret lathe or hand screw machine is the turret which is fitted to the ways of the lathe bed. This unit has a base 7 inches long in which there is fitted a dovetailed slide, 9 inches in length and having a 3-inch stroke. The turret is 4 inches in diameter, has six tool positions and will accommodate ⅝-inch standard Brown & Sharpe equipment. The indexing mechanism is fully automatic, and allowance has been made to permit travel for all overhanging box-tools. The indexing movement consumes but about 1⅛ inches of travel so that a movement of 1⅞ inches is obtained before the indexing pin on the turret is released.

The double cross-slide shown mounted on the lathe bed between the turret and the headstock consists of a main slide carrying two adjustable tool-post blocks, and an operating lever by means of which a rack attached to the bottom of the main slide is operated by a spur gear. Suitable stops

and a stop-pin are provided to govern the front and rear transverse movements of the slide, the stop being attached to the base of the attachment and the stop-pins to the main slide. Both the turret and the cross-slide are recommended by the manufacturers for heavy service and precision work.

In addition to the equipment shown in the accompanying illustration, the bed of this lathe will accommodate all Potter standard tool-room lathe equipment, including the special tailstock, hand-rest, compound slide-rest, steadyrest, universal grinding attachment, internal grinding attachment, milling attachment, etc. The maximum capacity draw-in chuck spring collet which the machine spindle can accommodate is ¾ inch. The swing over the bed is 7⅝ inches and the distance between centers is 16 inches. Both the headstock and the tailstock are fitted with No. 4 Jarno tapered holes.

HANSON-WHITNEY OIL-GROOVING ATTACHMENT

Probably it is safe to say that the oiling of slides in machinery has never received the same careful consideration that has been given to the oiling of revolving bearings, but accuracy and freedom from wear in a slide is just as important as in any other bearing of a machine. Oil-grooves are provided to distribute lubricant over a slide bearing, and when these grooves are chipped, the operation is expensive and the quality of workmanship is difficult to control. Many machine designers leave the question of making oil-grooves to the judgment of men in the machine shop; whereas, the form of grooves to be used should be definitely specified and standard tools should be available for their production. Many experienced machine designers prefer a V-shaped groove of about 120 degrees included angle to an oil-groove of half-round section, because it helps the oil to wedge itself between the wearing surfaces. Also, the oil-groove should be of the so-called zigzag form, as shown in the accompanying illustrations. The V-shaped groove has a further advantage in that it is possible to produce different widths of grooves with the same tool.

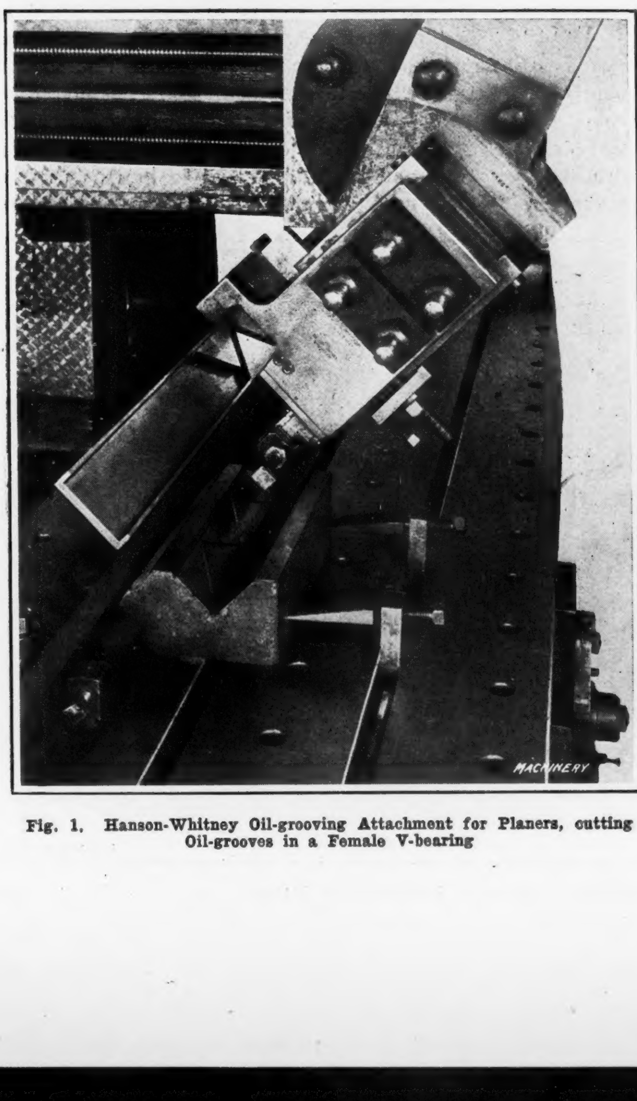


Fig. 1. Hanson-Whitney Oil-grooving Attachment for Planers, cutting Oil-grooves in a Female V-bearing

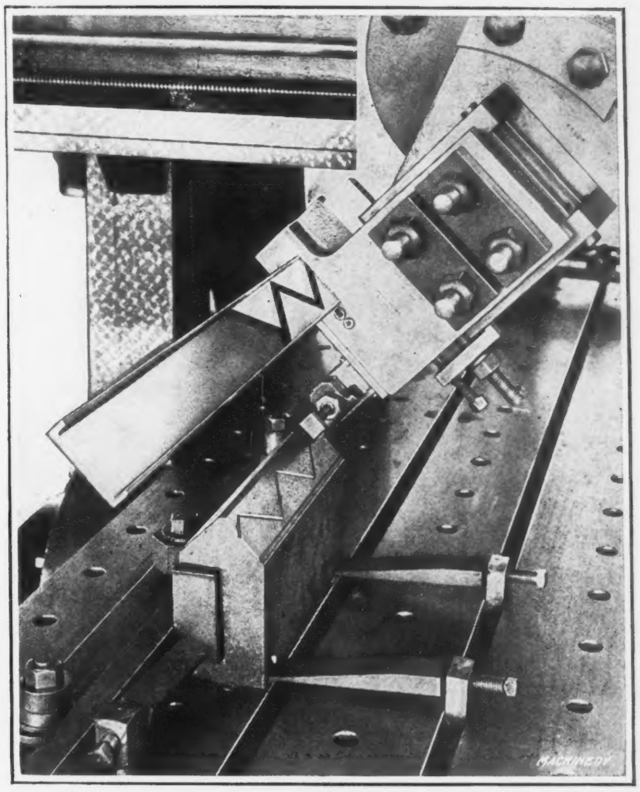


Fig. 2. Hanson-Whitney Oil-grooving Attachment for Planers, cutting Oil-grooves in a Male V-bearing

To provide for the rapid and accurate cutting of oil-grooves in slides, the Hanson-Whitney Machine Co., Hartford, Conn., has developed a planer attachment which is here illustrated and described. This device can be used on any standard type of planer, and it is furnished with a master cam which guides the oil-grooving tool to provide for producing a groove of accurate form. It is said to take practically no longer to set this tool up on a planer than it does other tools that are used on the machine; and attention is called to the desirability of cutting oil-grooves while a piece of work is on the planer, instead of making this an entirely separate operation.

Features of the Oil-grooving Attachment

This attachment is secured in place on the machine by means of the clapper bolts, and the holes are not drilled for this purpose, owing to the fact that the location of the bolts varies on different machines. In setting up the attachment, it should be located on the clapper so that the hook-bolt *A*, Fig. 5, touches the bottom of the clapper. When the hook-bolt is tightened, the clapper will be squeezed so that it cannot move. In the hook-bolt there is a hole into which a hardened bushing is driven; and a drill that fits this bushing should be used to drill a hole into the clapper-box. A pin which fits the hole in the hook-bolt should then be driven into the clapper-box, and this pin and the friction of the clapper squeezed between the fit of the box will hold the attachment firmly in place; but the bolts in the clapper-box should also be tightened up.

On the oil-grooving attachment there is a small clapper-box *B*, which can be adjusted along a reciprocating slide; and various widths of zigzag paths for the oil-grooves can be obtained by adjusting the clapper *C* which transmits movement from the cam bar to the reciprocating slide. The cam bar is attached to cross-piece *D*, which is connected to upright *E*, this upright being strapped to the planer table at a convenient position, while the cross-piece is located at approximately the correct height on the upright. The cam bar can slide vertically in the cross-piece, and the cross-piece slides horizontally on the upright, thus affording considerable freedom of action for the grooving attachment in both horizontal and vertical directions.

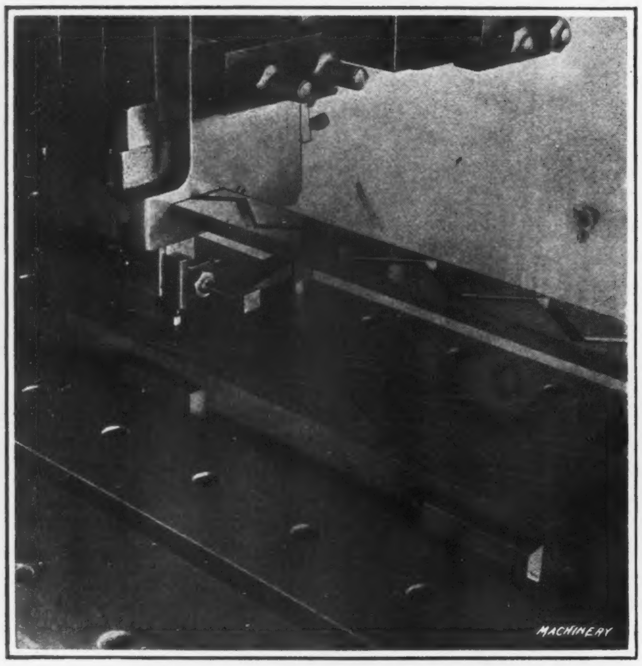


Fig. 3. Hanson-Whitney Oil-grooving Attachment for Planers, cutting Oil-grooves in a Flat Slide Bearing

Fig. 4. Holding Block used to obtain Correct Form in grinding Tools for Use on the Hanson-Whitney Oil-grooving Attachment

Forms of Oil-grooving Tools

Three forms of oil-groove cutting tools are used. For work where there is no projection, a straight tool is used and it is always located at right angles with the surface to be grooved. When an oil-groove has to be made in a dovetail, either a right- or a left-hand tool is employed according to the form of the work, and the tool should always swing at 45 degrees to give the required cutting angle. When cutting oil-grooves in V-shaped slides, such as those in a planer bed or on the V-part of a large planer table, the whole oil-grooving attachment is swung by adjusting the clapper-box or the vertical slide, or by a combination of these two movements. When planing grooves in a 45-degree angle V-bearing, it is found most satisfactory to swing the clapper-box to 20 degrees and the vertical slide to 25 degrees. On this oil-groove cutting attachment the maximum length of groove that can be cut is 30 inches; the maximum width of the zigzag path for the oil-groove is 1¼ inches, and the minimum width of the zigzag path is ⅜ inch.

Method of Procedure in Sharpening Tools

To provide for rapidly and accurately sharpening the cutting tools used on this planer attachment, a special holding block is furnished. Any grinder, such as the Brown & Sharpe surface grinder, or the Cincinnati cutter grinder, will give satisfactory results for this purpose. From Fig. 4 it will be apparent that the block is provided with grooves in which the cutting tool is strapped, so that the combination of the angularity of the groove and the supporting face of the block will provide for bringing the tool into contact with the grinding wheel in such a position that the desired form of tool point will be secured.

EXHAUST ATTACHMENT FOR SURFACE GRINDERS

Modern requirements for the safety and health of employes demand an efficient device for disposing of the dust generated by grinding machines, especially surface grinders, when operating without the use of water, which is so frequently necessary. Where these machines are not placed in groups to be served from one central exhaust system, it is most desirable to have each individual machine equipped with its own unit, and in many cases it is really more economical to have each machine of a group individually

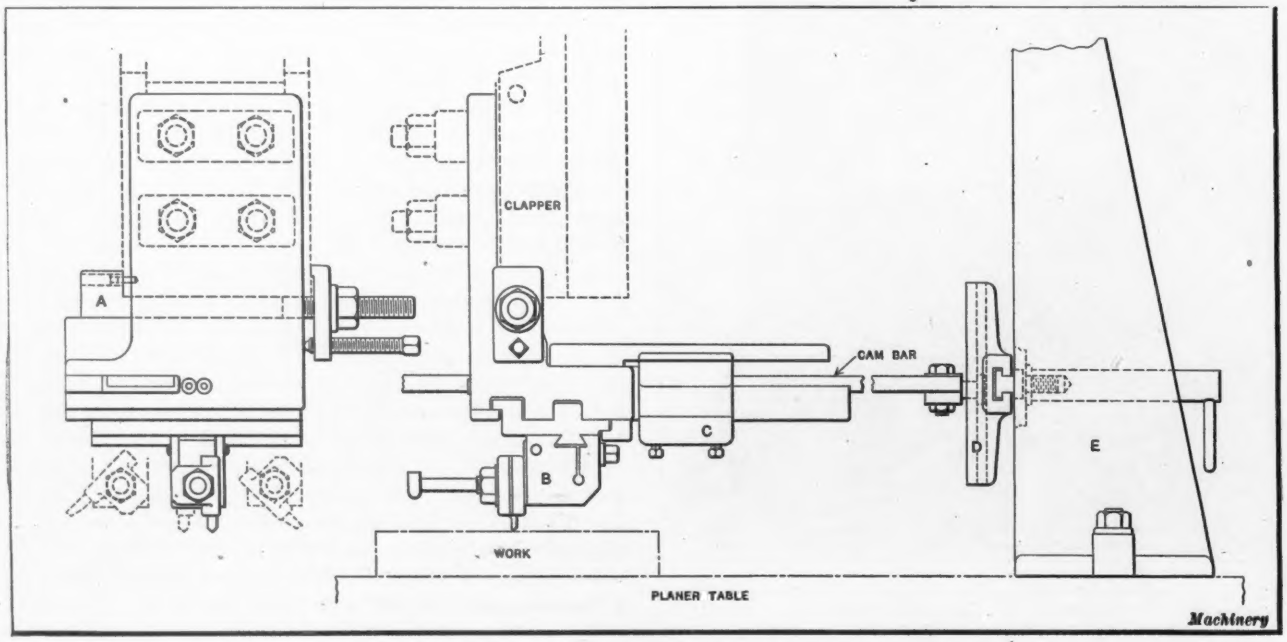


Fig. 5. Details of Construction of the Hanson-Whitney Oil-grooving Attachment for Planers

equipped, as the exhauster is then running only while the machine is operating. This is especially true with individual motor drive.

Realizing the importance of collecting at least 90 per cent of this dust, the Abrasive Machine Tool Co., East Providence, R. I., designed a complete new system for its machines. This exhauster is equipped with S K F ball bearings, and an aluminum fan running at 4000 revolutions per minute. It is connected with the aluminum dust collector on the grinding wheel hood by means of a large flexible wire-insert rubber suction tubing. The wheel dust is drawn in through the flexible tubing, and forced into the centrifugal drum attached to the rear of the machine, where the dust is separated and deposited at the bottom of the cone. The free air passing out through a circuitous route is practically dustless. The accumulation of dust can be easily removed by unscrewing a cap at the bottom of the separator drum, which should be attended to each morning.

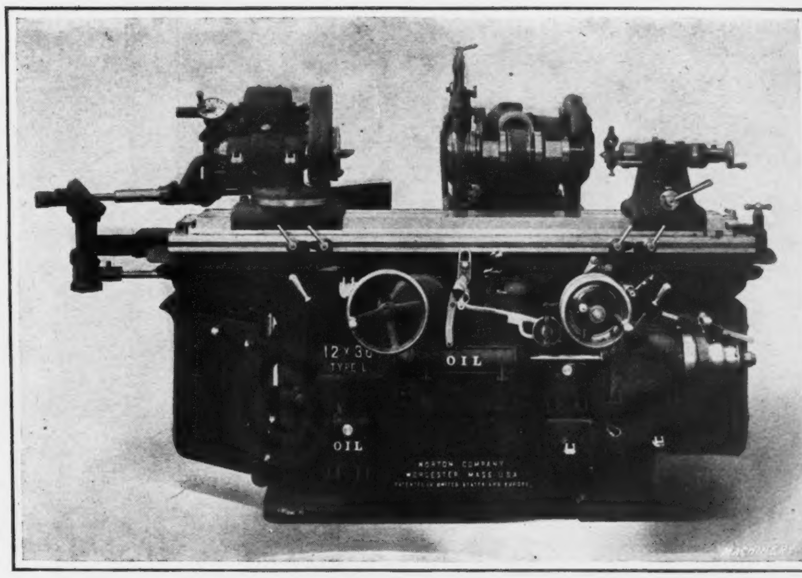


Fig. 1. Universal Multipurpose Grinding Machine built by the Norton Co., Worcester, Mass.

NORTON UNIVERSAL MULTIPURPOSE GRINDING MACHINE

A universal grinding machine embodying in its design several new features in grinding machine construction has been brought out by the Norton Co., Worcester, Mass., this machine being known as a 12- by 36-inch Type L, universal multipurpose grinding machine. There are two main features about this machine that particularly demand attention. One is that the machine is entirely self-contained, having a single-pulley drive, the belt to the pulley on the main drive shaft passing to the rear of the base of the machine, as indicated in Fig. 3. The pulley is enclosed in a belt guard, the latter being so attached to the base that it may be rotated so that the machine may be driven from a pulley on an overhead lineshaft in any position, or from a motor on the floor.

The other main feature which embodies entirely new ideas of design is the method of transmitting power from the countershaft in the base of the machine to the wheel-spindle, which is done in such a manner that the belt, passing up over idler pulleys, can be twisted to any of the positions to which the wheel-head may be set either for regular or internal grinding. This arrangement of the driving belt to the wheel-spindle has made it possible to make the wheel-head double-ended, carrying the regular wheel-spindle at one end, as shown in Fig. 1, and an internal grinding spindle at the other. The wheel-head may be turned through 180 degrees for placing the internal grinding spindle in the operating position, as shown in Fig. 2, where the regular wheel spindle is at the rear, the wheel being replaced by a pulley that drives the internal grinding wheel spindle by means of a belt. The wheel-head is graduated on the base in degrees, and the cross-slide may be rotated to any angle. The belt drive to the wheel-head is so arranged with idlers, as mentioned, that it is not affected by the swiveling of the wheel-head.

The wheel-spindle runs in bronze boxes, tapered on the outside for adjustment. The end thrust is taken by a collar on the spindle. The wheel-spindle is made of heat-treated alloy steel and is double-ended, each end being arranged to carry wheel sleeves for grinding wheels 12 inches in diameter, from ½ to ¾ inch thick, and with a 5-inch hole. The wheel feed is either automatic or by hand, and operates independently of the position of the cross-slide relative to the work-table. The automatic feed at each reversal of the table can be set to reduce the diameter of the work from 0.00025 to 0.004 inch, by increments of 0.00025 inch. The wheel feed is provided with a stop for automatically disengaging the feed when the work has been ground to size.

The drive to the headstock is through a splined shaft, as shown to the left in Fig. 1 and to the right in Fig. 2. The speed changes are obtained through a gear-box, six work speeds ranging from 53 to 320 revolutions per minute being obtainable, these speeds being entirely independent of the table or wheel speeds. The spindle is hollow so that rods up to ¾ inch in diameter may pass through it. Provision is made so that the center may be rotated or dead, as required.

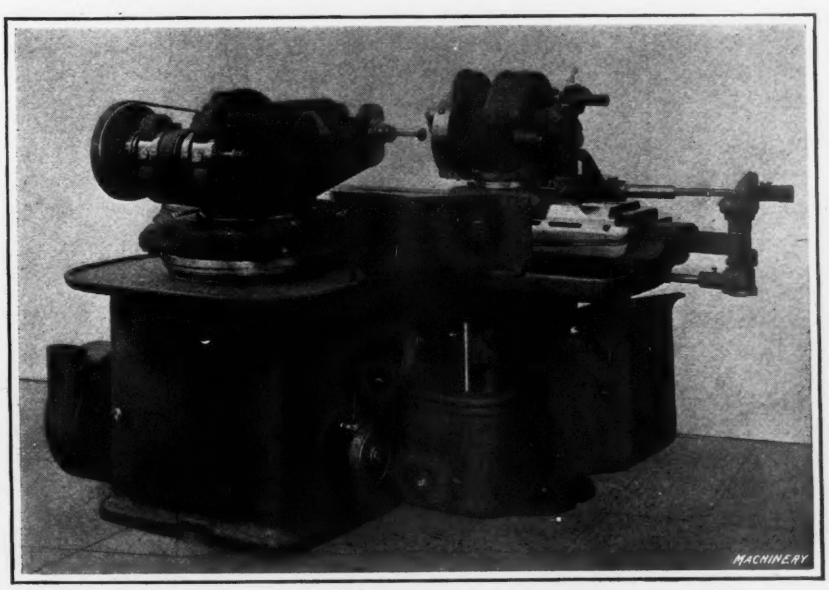


Fig. 2. Rear View of Norton Universal Grinding Machine showing Internal Grinding Spindle in Working Position, and the Regular Wheel-spindle at the Rear

The table speeds are obtained from a four-step cone pulley, shown to the right in Fig. 1, in conjunction with back-gears. Eight table speeds are available, ranging from 2 to 11½ feet per minute. The table is made in two parts, the top table swiveling on a stud in the center, and having clamping provisions at both ends. At the right-hand end, Fig. 1, graduations are provided on a triple scale up to 7 degrees, 3 inch taper per foot, or 25 per cent taper. The top of the swiveling table is flat and provided with a T-slot for holding steadyrests and splash guards, this T-slot running the entire length

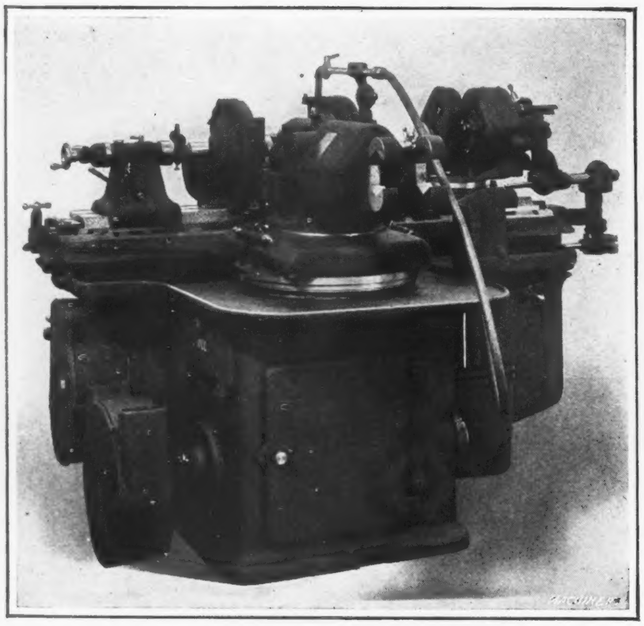


Fig. 3. Rear View of Norton Universal Grinding Machine, showing Arrangement for Single-pulley Drive

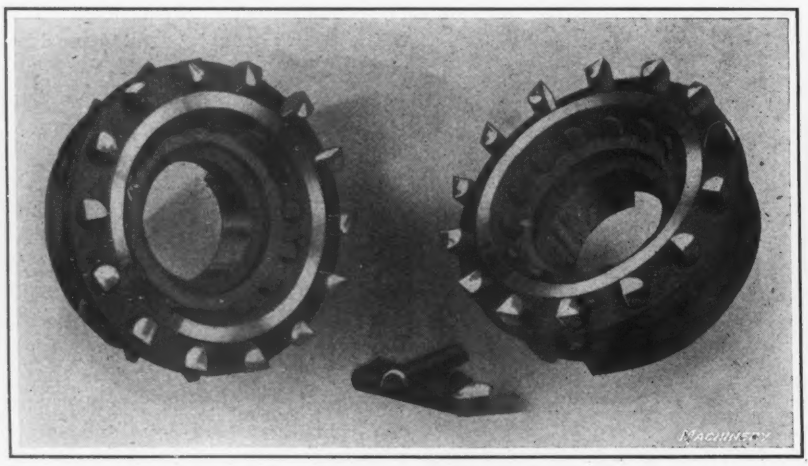
of the table. The lower or sliding table is equipped with the reversing dogs, and guards extending downward to protect the ways of the base.

Rolls in oil wells in the base provide for uniform oiling of the ways. The reversing mechanism for the table is the same as that used on the regular Norton cylindrical grinding machines. The footstock is of the combination lever and screw type held by an eccentric clamp to the table. A diamond tool-holder is provided, which is mounted on the tail-center for truing the wheel.

The pump is belt-driven and is of the centrifugal type. The connection to the water pipe and nozzle on the wheel-head is by a flexible steel hose, as shown in Fig. 3. The settling tank is hinged to the base of the machine, as shown to the left in Fig. 1 and to the right in Fig. 2, and is easily tipped down for emptying it, or removed for cleaning. The machine is provided with regular equipment of chucks, steadyrests, wheel sleeves, dogs, tooth rests, splash guards, and wrenches. The approximate net weight of the machine, with regular equipment, is 4950 pounds, and the approximate floor space is 11 feet 8 inches by 5 feet 5 inches.

LOVEJOY FACE MILLING CUTTER

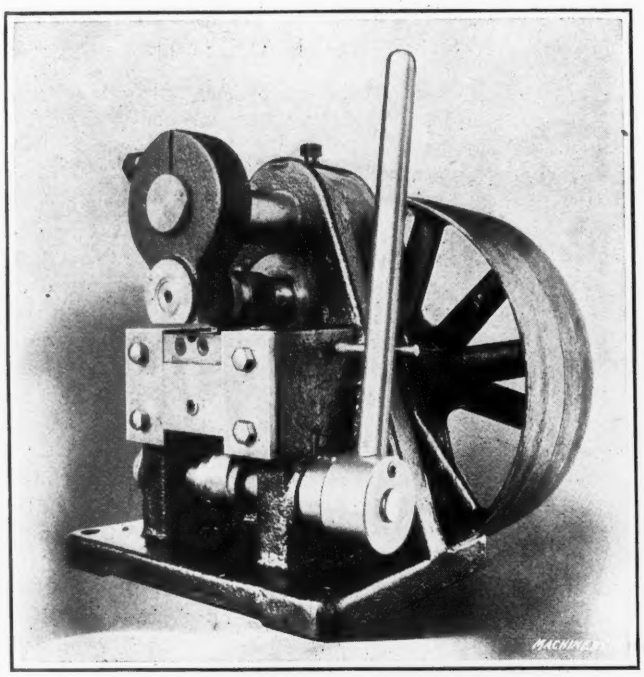
The Lovejoy Tool Co., Inc., Springfield, Vt., has added to its line of tools a Type A face milling cutter, which is recommended for use in all cases where the depth of cut does not exceed 9/16 inch. The teeth of this cutter are positively locked, and it is claimed that there is no possibility of their slipping or loosening under heavy or intermittent cuts. The teeth are made to gage, and they are interchangeable, with a liberal amount of stock provided for wear. The bodies of the cutters are made from hardened steel. The way in which the teeth are adjusted forward to compensate for wear, or replaced with new ones when necessary, is made quite obvious from the illustration. It is stated that this type of milling cutter body holds stellite teeth in a very satisfactory manner, and teeth made of this material may be furnished on special order. Standard tools of this kind are made in nine different sizes, with diameters ranging from 6½ to 18 inches.



Type A Face Milling Cutter made by the Lovejoy Tool Co., Inc.

GRAY BENCH KNURLING MACHINE

The machine shown in the accompanying illustration is particularly adapted for knurling cylindrical work without centers, such as shafts, pins, etc., which have been cut from the bar. The product from screw machines can also be handled advantageously. One knurl is used, which is mounted on an arbor running in bronze bearings, driven through reduction gearing from the driving pulley mounted at the rear. An overhead arm carries the outboard bearing for the arbor. A knee, movable vertically by means of a cam nd lever, and adjustable for height, carries two hardened and ground rollers running in hardened bearings, which support the work to be knurled. In operation, the work is placed in position on the rollers with one end against an adjustable locating stop. The work revolves when brought into contact with the knurl by means of the hand-lever, which, through the cam, raises the knee. In cases where the entire length of the work is to be knurled, leaving no blank spaces for bearings, knurls are substituted for the plain rollers, giving the effect of three knurls in contact with the work. This machine is a recent product of the Gray Machine & Parts Corporation, Batavia, N. Y. The illustration shows a bench type of knurling machine, but equipments will be built with legs for handling larger work.



Bench Type of Knurling Machine built by the Gray Machine & Parts Corporation

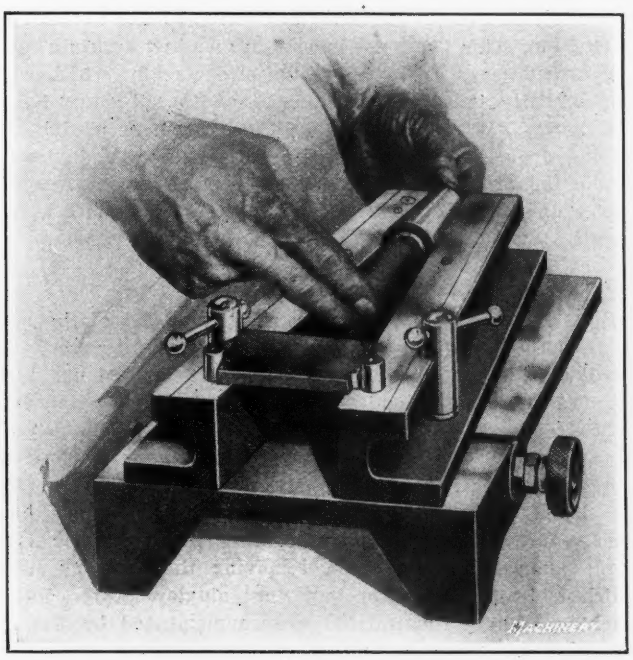
DOYLE-WALL TAPER GAGE

For use in making precision measurements of tapered work, that are required when originating tapers or duplicating those that are

already in use, the Doyle-Wall Machine & Tool Co. of 318-324 Pearl St., Syracuse, N. Y., has recently developed a double sine bar and angle-measuring gage, which is here illustrated and described. It consists of steel parallels mounted on angle-bars which are pivoted on pins set in a baseplate and operated simultaneously, for convergence or divergence, by means of an adjusting screw. When the required taper has been established, the bars are immovably secured in position by means of lock-nuts.

It is claimed that this gage constitutes an exceptionally rapid though accurate method of measuring tapered work. To set the gage, reference is made to a chart on which twice the sines of one-half the angles are tabulated, and the gage is then adjusted by turning a knurled nut until the specified micrometer reading is obtained across the ½-inch movable measuring pins. This will give the correct taper per foot over a range from 0 to 4 inches per foot. A chart, figured to four decimal places by intervals of 1/16 inch from 1/16 inch to 4 inches, is supplied with each gage. After the gage has been set for a given taper, it will measure as many pieces of work as desired without requiring further adjustment.

Any mechanic who can read a micrometer can use this gage, as there is only one measurement to be taken over the

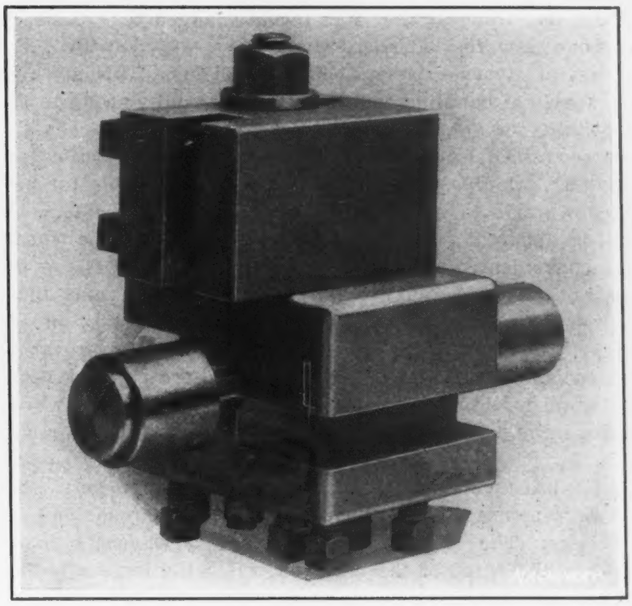


Taper Gage made by the Doyle-Wall Machine & Tool Co.

measuring pins. If it is desired to use precision gage-blocks, measurements are taken between the ½-inch pins. It is stated that with ordinary care, this precision taper measuring gage may be depended upon to give perfect service indefinitely. The parallels and pins are hardened, ground, and lapped to a high degree of accuracy. This gage is regularly made in two sizes, with 12-inch and 6-inch centers; but special gages will be made in any size to take any desired taper.

"ASHMAC" COMBINATION TOOL-HOLDER

The "Ashmac" combination tool-holder which is here illustrated and described is a recent product of the Ashley Machine Works, 714 University Ave., Rochester, N. Y. These tools are made in two sizes, known as No. 1 and No. 2, and each size of tool-holder is furnished with a tool-block, a pilot stem, and a pilot bushing of any standard size. The pilot stems are made in four different sizes, known as Nos. 3, 4, 5, and 6, and a wide range of different sized bushings are made for each size of pilot stem. These bushings range in size from ⅝ inch to 3 inches, varying by steps of 1/16 inch. For the No. 3 pilot stems the bushings range from



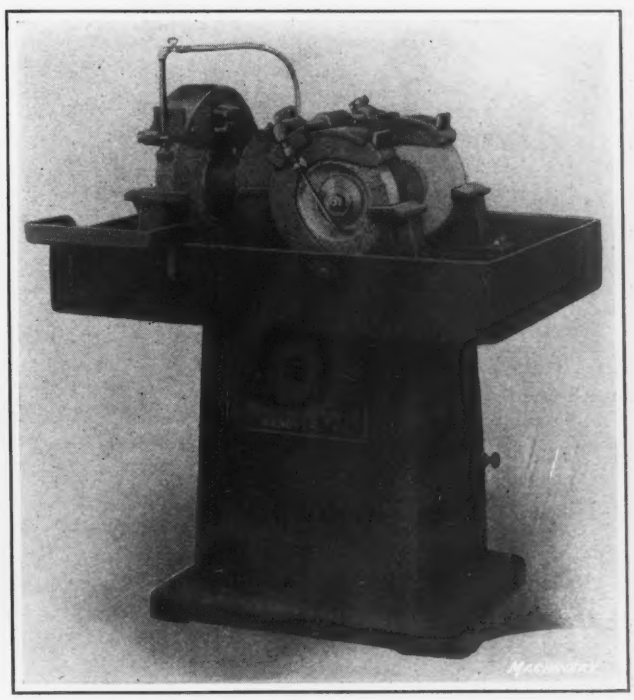
"Ashmac" Combination Tool-holder made by the Ashley Machine Works

⅝ to ⅞ inch, inclusive; for the No. 5 pilot stems the bushings range from 15/16 to 1½ inches, inclusive; for the No. 4 pilot stems the bushings range from 1 inch to 1¾ inches, inclusive; and for the No. 6 pilot stems the bushings range from 1 13/16 to 3 inches, inclusive. All bushings are ground 0.001 inch under size.

The No. 1 size of tool-holder has a 1¼-inch shank, and it is equipped to carry ½-inch tools. The pilot bushings range from ⅝ inch to 1½ inches, inclusive, by steps of 1/16 inch; and two pilot stems (Nos. 3 and 5) are made for this size of tool-holder. The No. 2 "Ashmac" tool-holder has a 1½-inch shank, and it is equipped to carry ⅝-inch tools. The available pilot bushings for use with this tool-holder range from 1 inch to 3 inches, inclusive. Either of two pilot stems may be used, a No. 4 stem carrying bushings from 1 inch to 1¾ inches, inclusive; and a No. 6 stem carrying bushings from 1 13/16 to 3 inches in diameter, inclusive.

MUMMERT-DIXON OILSTONE GRINDER

For use in the performance of miscellaneous tool grinding operations in machine shops and tool-rooms, the Mummert-



Triple-purpose Oilstone Grinder built by the Mummert-Dixon Co.

Dixon Co., Hanover, Pa., has recently added to its line an oilstone wet tool grinder which is equipped with three grades of stones—coarse, medium, and fine. This machine is capable of handling such work quite rapidly, owing to the possibility of quickly bringing large tools to shape on the coarse-grained wheel; the medium wheel is well suited for ordinary grinding, and the fine wheel is adaptable for producing a smooth finish on the cutting edge of the tool. It will be apparent from the illustration that all of the wheels are conveniently arranged for the operator and, if so desired, three men can use the machine at the same time. Kerosene is used on the wheels to prevent glazing and to keep them clean and sharp, and also to avoid overheating the tools. A small centrifugal pump located at the bottom of the oil reservoir is used to deliver kerosene to the wheel, and a large pan catches the oil and returns it to the reservoir.

Ball bearings support the grinding wheel arbors, and they are mounted in housings provided with grease and oil retainers. The arbor which carries two wheels runs at one-half the speed of the arbor on which the large grinding wheel is mounted, and it is driven from the first arbor by a set of bevel gears having a ratio of 2 to 1, which are enclosed in an oil-tight gear-case filled with grease. Regular equipment furnished with the machine includes one coarse-grained oilstone wheel, 16 inches in diameter by 2 inches face width; one medium oilstone wheel, 10 inches in diameter by 2½ inches face width; one fine oilstone wheel, 10 inches in diameter by 2½ inches face width; a ball-bearing countershaft for a belt-driven machine, and a motor belt tightener for a motor-driven machine.

H. E. HARRIS THREAD GRINDING MACHINE

While practical difficulties have retarded the commercial application of thread grinding, there is a demand for more accurate threads, and these cannot be produced without accurate taps and dies, nor can they be checked without accurate thread gages. There is also a demand for accurate worms and worm-gear hobs which cannot be produced without accurate means of grinding them. During the past five years, the H. E. Harris Engineering Co., Bridgeport, Conn., has ground a large number of taps, hobs, and thread gages for its customers and found that tools thus ground would improve both the accuracy of the work and the amount of production. This firm's experience in grinding accurate taps and thread gages led to the design of a machine which will commercially and accurately grind taps, thread gages, hobs, and worms. It is suited both to highly accurate production of one or a few thread gages and to quantity duplicate production of taps, worms, etc. It requires only an operator taught to do the work and not a highly skilled mechanic.

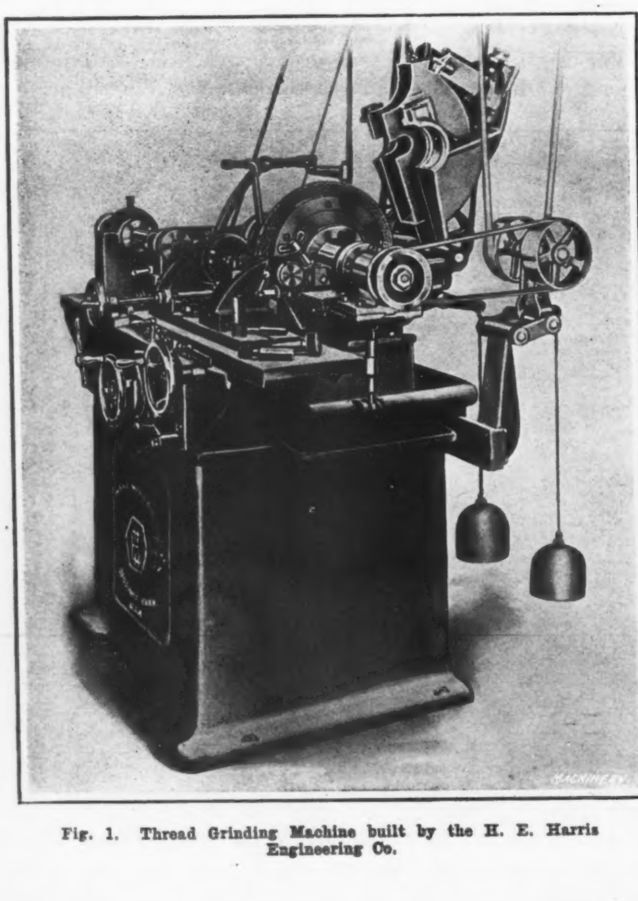


Fig. 1. Thread Grinding Machine built by the H. E. Harris Engineering Co.

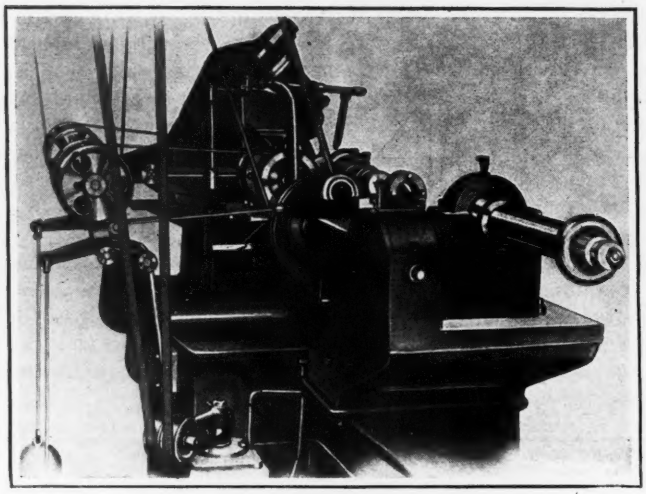


Fig. 2. End View of Harris Thread Grinder showing Arrangement of Drive

Features of the Machine

Fig. 1 shows a view from the right-hand end of the machine with the upper bearing caps carrying the lubricant guard and angular diamond truing devices hinged up. Fig. 2 shows the left-hand end view with the lead-screw removed with its two-piece nut, the lead-screw drive, the pump and the uniform belt tension device. Fig. 3 shows a close-up view of the work, the grinding wheel, and the diamond truing device. In this view the upper lubricant guard has been removed so as to show the other parts more clearly. Fig. 4 shows the method of removing the grinding unit which is by far the most important single feature of the machine. These illustrations are supplemented by Fig. 5 which shows the construction of the grinding head, the diamond truing device, and the drive, and Fig. 6 which shows the method of driying the work to give it the correct lead without a side movement which would destroy the grinding wheel and prevent accuracy.

The grinding wheel on this machine is of prime importance. To eliminate rapid wear of the cutting edge and bearings, and to provide for using high rotative speeds, the grinding wheel is made 16 inches in diameter, presenting to the work a continuous edge at each revolution, that is 50¼ inches long or a turn of about 4¼ feet to each cutting particle before it contacts with the work again. At 1600 revolutions per minute, a surface speed of 6700 feet per minute is obtained, thus combining a relatively low rotative speed with a high surface speed. The grinding wheel is a ring of abrasive material clamped in the rim of a very heavy and accurately balanced gyrostatic wheel. This essential feature of a perfectly balanced and heavy flywheel or gyrostat maintains the grinding edge in a true path, at a uniform speed and without vibration. Due to its weight, it absorbs any shocks from inequalities caused by flutes in taps or hobs; and due to its momentum, the wheel keeps a uniform rate of speed, despite possible changes in belt power, and overcomes uneven resistances due to high spots in the work or as the work is fed on or off the grinding edge. In this way it prevents any tendency toward sudden retard-

ation or acceleration of speed; and also due to the gyrostatic action of this balanced mass, it exerts ample power to resist changes of axial or lateral position and tends to hold the entire rotating mass in a floating position between its bearings. This not only takes any undue pressure off the journals and bearings, but holds the wheel in a true rotative position and prevents errors due to side thrust movement or elliptic action.

Arrangement of the Driving Mechanism

This gyrostatic wheel *A*, Fig. 5, is forged in one integral piece with its two journals *B* which rotate in double ball bearings, and it is turned all over and balanced to a perfect running or gyrostatic balance. Belt pressure or alignment strains are not allowed to affect this wheel, the drive being transmitted to it at each end from driving pulleys *C* carried by independent shafts and bearings. Flexible couplings *D* and driving jaws transmit power from these auxiliary pulley shafts to the wheel-spindle, and therefore a purely rotative drive is imparted. The two belts are of jointless fabric, and an equal pull is kept on both of them by weights *E* through a pivoted bellcrank tightener, which also keeps the overhead countershaft belts under a uniform tension.

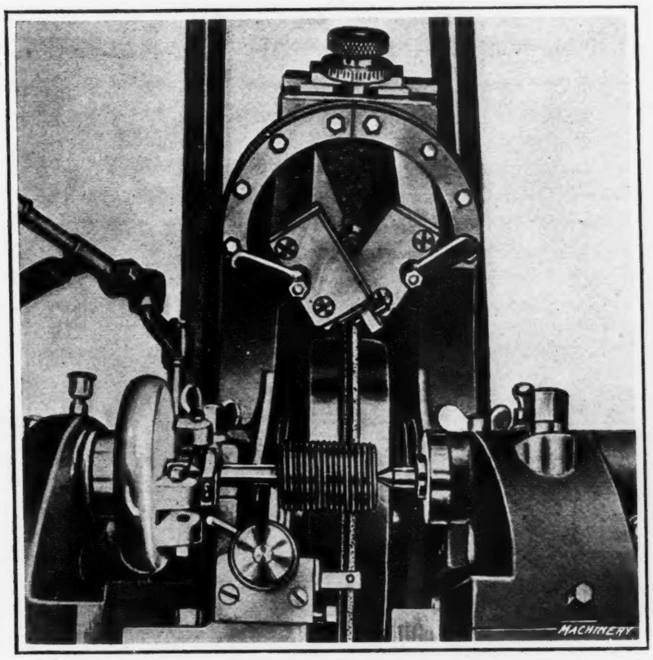


Fig. 3. Close-up View of Wheel-truing Device and Work on Harris Thread Grinder

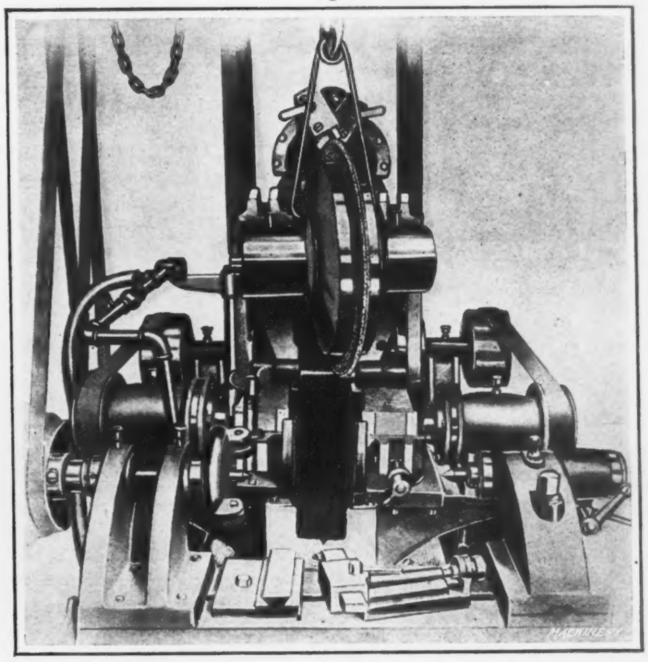


Fig. 4. Close-up View showing Method of lifting the Wheel and Arbor out of the Bearings

Construction of the Grinding Wheel

The abrasive wheel is a special ring made for this machine. Its weight is only a few ounces, compared to the 200 pounds weight of the gyrostat carrying this ring, so that even were the abrasive material not absolutely uniform in weight, the running balance would not be materially affected. The ring-wheel is clamped by a circular dovetail, and should it be cracked in segments it will not fly apart. These parts would maintain their positions and the wheel could be used for grinding and be dressed occasionally as required, just as though the ring were not cracked. The rings are made in vitrified, silicate and elastic abrasives, and a special ring has been devised particularly for the purpose of thread grinding, in which the section on the vertical plane through the center of the ring and apex of its dressed edge is made of a harder binder and a finer grit than the outer sides, so that the V-shape may be maintained longer without redressing when grinding into the root diameter of the threads. This fine extreme outer edge is what ordinarily wears away and loses its shape the fastest, although it removes the least metal, and making it finer and harder adds greatly to its efficiency. As this hard, thin section extends from the apex of the cutting edge clear down through the ring to its inner diameter, it is not dressed away when truing, even when the ring has been dressed down to its minimum size and barely projects beyond the metal surfaces of the gyrostat.

The ball bearings are of the fully enclosed labyrinth type, without felt washers; once adjusted and lubricated, they need little attention, and they are permanently carried on the gyrostat wheel journals, even when removing the wheel to replace a worn out abrasive ring with a new one, as shown in Fig. 4. They may be instantly removed by unscrewing nut *F* and can be disassembled in a few minutes. The wheel is removed by loosening the two wing-nuts *G* on the swing-bolts, and swinging the upper members upward and back on their pivots. The angular wheel-truing devices *H* and metal splash guard are carried up out of the way with this upper member, as shown in Fig. 4. The upper member is released to swing back merely by loosening the two thumb- or wing-nuts without disturbing the set-up or any other part of the machine, and the wheel is replaced just as readily. No great pressure is required on the wing-nuts, as the machine will actually operate and the wheel will grind without the upper member, so great is the effect of the gyrostatic action after speed of rotation has been attained.

The wheel operates under full flooded lubrication from the pump shown in the lower left-hand part of Fig. 2. Two large circular separation disks *I* with holes in them to assist in removing the wheel (see Fig. 4) are forced on the gyrostat hubs and balanced with the gyrostat as part of it. They keep any of the cooling compound from working out beyond them and also keep any oil from the bearings from working over on the wheel—thus the term "separation disks."

Wheel-truing Device

The cutting or grinding edge is dressed or trued to the required form by a set of three diamond tools which can be operated while the machine is grinding work if desired. They are located so as not to interfere with the work in any case. The two diamond tools for truing the angular faces of the grinding edge are shown in Fig. 3, where the upper metal splash guard has been removed for clarity. The diamond tools are carried in two rack-operated slides controlled by hand-levers. One of these slides is set slightly under the other so that they may cross in a line in the diametral plane of the apex of the cutting edge. The main

truing slide carries the points of these tools inward on a radial line toward the center of the grinding wheel and keeps the crossing point of the two diamonds on this diametral plane. Therefore, as the main truing slide is fed in toward the center, the apex is not shifted laterally; but the angles of the trued faces remain constant and the only change is the gradual reduction of diameter of the cutting edge. In other words, once set for the desired angles, the wheel will always be dressed or trued to these angles without any change in relation to the work, except that whatever amount the slide *J* is fed in by its micrometer screw to dress the wheel, that same amount must slide *K*, carrying the wheel-head, be fed into the work by the micrometer screw controlled by the middle handwheel shown in Fig. 1. These diamond tool-slides can be adjusted to any angle, from an almost vertical position to a horizontal position, by swinging their frames about their common pivot.

Adjustment for the Helix Angle

The entire wheel-head mechanism and the pulley drives are carried on a circular sliding saddle *L* which is adjusted about the intersection of the axial and diametral centers of the grinding wheel to the required thread or worm helix angle by the adjusting link *M*. Saddle *L* is securely clamped, by four screws *N* passing through oblong slots, to the wheel-head carriage *K*. The axis of the wheel and the axis of the work are in the same horizontal plane so that this angle is in the correct relation where it contacts with the work. Slide *K* is moved toward or from the work by a handwheel which has a micrometer dial and operates through a worm, worm-gear, rack, and pinion.

An automatic feed operates this handwheel at every stroke of the carriage, feeding it in the desired amount after each cut, and an adjustable stop motion is supplied so that when the grinding wheel has been fed in to the required depth to produce the desired diameters of the work, this feed is thrown out. This permits automatic reproduction of duplicate work, the wheel-head only being adjusted by hand for the amount dressed off by the angular diamond tools.

The diamond tool *O* is shown in the working position for dressing the flat or land on the periphery of the wheel. Its base is adjustably clamped to the work-slide in a fixed relation to the work-centers, so that when once set it will continue to dress the periphery of the wheel as the wheel-slide is fed in, producing the correct root diameter without changing or adjusting. This diamond tool is carried in a small rack slide, with a motion at right angles to the plane of the wheel and parallel to its axis, thus always dressing a flat edge as required. The amount it may be set in relation to the work-slide is controlled by a micrometer screw adjustment. While generally left in place while the machine is operating, it is so arranged that it can be removed to accommodate large diameters of work up to the extreme capacity of the machine. All diamond dressing is done on a flooded wheel resulting in a long life to the diamonds.

Method of Controlling the Lead of the Ground Thread

The method of controlling the lead of the thread ground on this machine is to reproduce the lead from an accurately cut or milled master screw, which is connected in rigid continuity with the work to be ground. The work to be ground is carried between centers, the dead or tail center *P*, Fig. 6, being of the spring type usually employed in grinding machines, with a clamp for locking it into position. This holds the work against a live center on the end of the headstock or revolving spindle, and the work is driven by a dog or other driving device clamped rigidly to the driver provided with jaws for such clamping. The live spindle *Q* is fitted with bearings having adjustment to remove all lost motion. These bearings are fully protected from the possibility of dirt, grit, or cutting fluid working their way in. The lead-screw *R* is carried in perfect alignment with the live spindle, and is secured to it by the clamp *S*, the bore of which is a true gage fit on the cylindrical end of the lead-screw. This carries the right-hand end of the screw, while the other support of the screw is the two-piece nut *T*. The stationary portion of the nut is tapered on the outside and drawn up and clamped by the knurled nut in a tapered hole in the upper member of the auxiliary adjusting slide which has an exceedingly fine screw adjustment operated by a handwheel This handwheel is shown on the upper left-hand side in Fig. 1 and gives a delicate adjustment to "catch the thread" by moving the nut, lead-screw, and slide with the work longitudinally across the cutting edge of the grinding wheel. This can be used either when the lead-screw and work are turning or when they are at rest. Provision is made for taking up all lost motion between the screw and nut, thus eliminating any side movement between the work and the

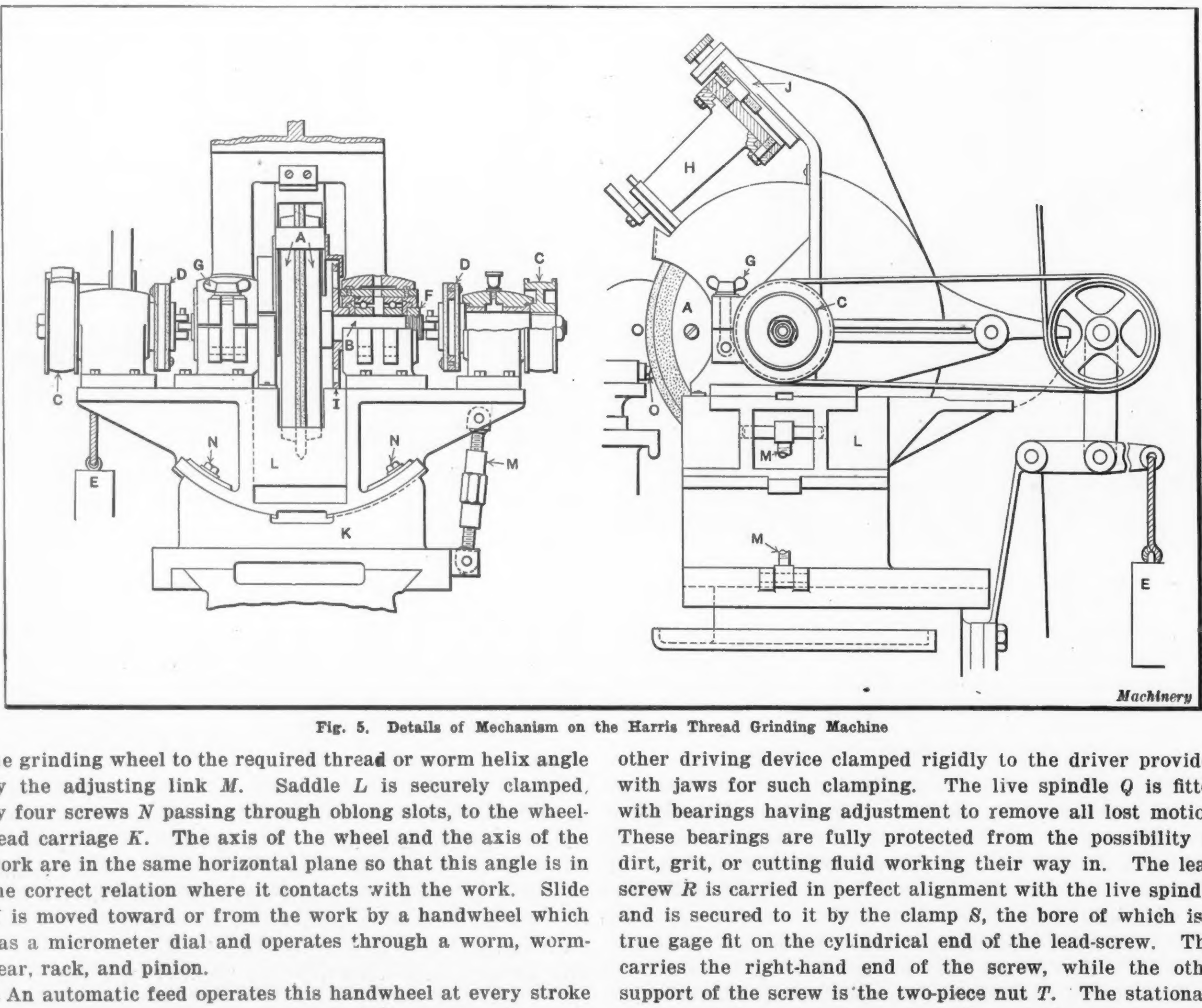


Fig. 5. Details of Mechanism on the Harris Thread Grinding Machine

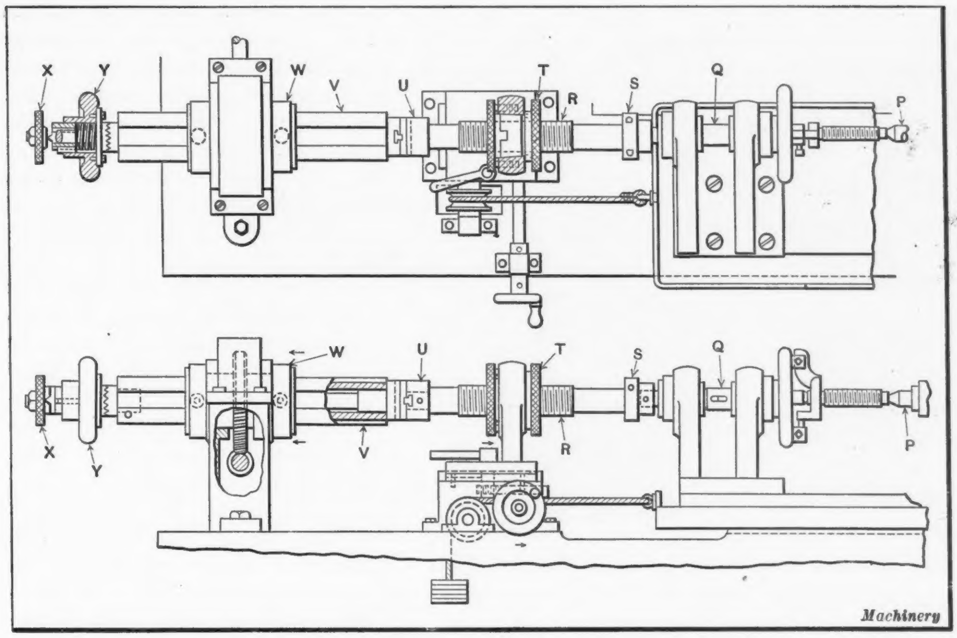


Fig. 6. Arrangement for controlling Lead of Thread on the Harris Thread Grinding Machine

grinding wheel, which would have the same effect as side thrust of the grinding wheel, namely, to grind on the left side of the thread when fed to the right, making a wide thread with a flat bottom, and also rapidly destroying the cutting edge of the wheel by side pressure. This effect of taking up slack is supplemented by a counterweight which is just sufficient to offset the inertia of the work-table.

Method of Driving the Lead-screw

The left-hand end of the lead-screw clamps in a full floating coupling *U* on the end of the floating follower spindle *V*. This follower spindle, which transmits the rotary motion to the lead-screw, work, and table, is made full floating with eight ball bearings so that no drag, side pull, or other strains can be transmitted from it while turning the lead-screw. The worm drive to this spindle consists of a worm-wheel driven by a worm from the reverse gear and mounted on and rotating a large hollow spindle *W* carrying eight ball bearings on pins, which work in four wide grooves or keyways, in the follower spindle. The four-grooved spindle *V* is made hollow and carries within it the spindle which directly carries the full floating coupling *U*.

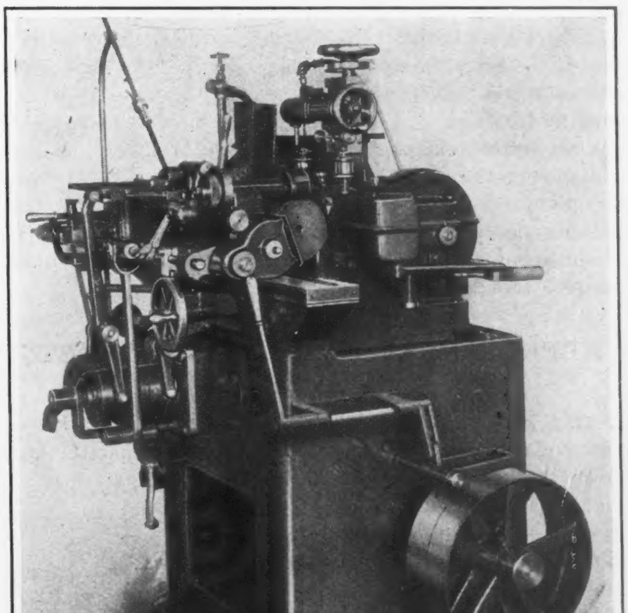
At the extreme left in Fig. 6 there is shown a knurled knob *X* which can be turned to connect or disconnect a clutch which transmits rotary motion from the outer grooved or keywayed follower spindle *V* to the inner spindle carrying the floating coupling *U* that drives the lead-screw *R*. When this knob is turned so that the clutch is out, the lead-screw and work may be freely turned by hand by the handwheel *Y* or by the periphery of the driver on the work-spindle. This clutch between the two spindles also has a spring release designed so that any undue strain tending to retard the work-table, such as would occur if the reverse gear were set for left-hand threads when a right-hand lead-screw was in the machine, would cause it to throw out instead of breaking some part of the machine. The change from right-hand reversing to left-hand reversing is done by means of the small lever shown toward the left end of the machine in Fig. 1. The reversing gear is driven direct from the cone pulley on the end toward the wheel-head. This pulley is driven from a separate shaft on the double countershaft and has four speed changes, and an additional range of work-speeds, by gearing. It may be stopped by a separate belt shifter without stopping the grinding wheel. This cone pulley is keyed to its shaft by a safety shearing device. Additional speed changes, if required, may be arranged by substituting cone pulleys on the double countershaft. As it takes a few minutes to get the gyrostatic wheel up to speed and as the bearings do not heat, it is advisable to leave the wheel drive running, while stopping the work drive only, except when the machine is not going to be used for some time.

The reversing of the lead-screw is done the instant the grinding wheel leaves the thread of the work by means of dogs on the front of the table operating the reverse lever shown projecting up from behind the middle handwheel, Fig. 1, and at the same time the automatic feed to the wheel-slide operates, feeding the wheel in for the next cut.

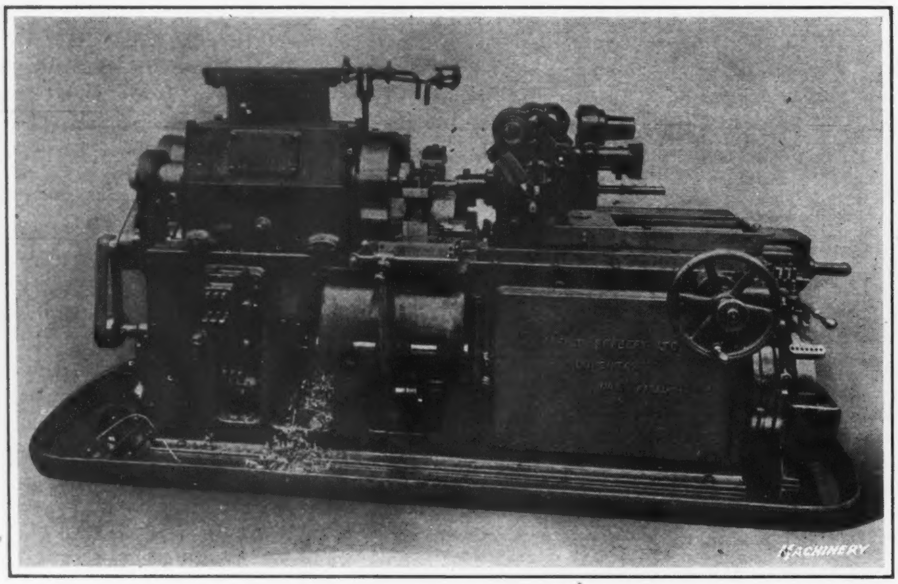
Reversing the lead-screw motion turns the work thread back through the same helical path against the wheel, and the wheel cuts continuously both ways, the automatic feed operating at either end of the table (or lead-screw) travel. By this means the backing out at the end of a single stroke and running back for the next cut is avoided. Besides practically cutting the grinding time in half, this grinding back and forth seems to give a keener cutting action and smoother finish than when grinding threads from one end only. The lead-screws can be very easily changed, in less than a minute's time. The handwheel to the right, Fig. 1, moves the table direct through a rack and pinion, and is a convenience when changing lead-screws. It cannot be operated by hand when the lead-screw is in.

FRASER AUTOMATIC GRINDING MACHINE

The grinding machine shown in the accompanying illustration has been recently placed on the market by the Warren F. Fraser Co., Westboro, Mass. This machine is designed primarily for grinding rolls and the first machines



Fraser Automatic Grinder designed primarily for grinding Rolls



Alfred Herbert No. 5 Automatic Lathe

of this type were built for the Bock Bearing Co. The machine is entirely automatic in operation and although built especially for roll grinding it can be adapted for grinding many different articles which are required in sufficient quantities to warrant the use of an automatic grinder. Among the notable features of this machine are its rigid construction, the method of protecting its bearings from emery dust, the three-bearing wheel-head, the three-bearing headstock, and a live tailstock and reciprocating wheel-spindle.

The wheel-dressing device is permanently mounted on the wheel-head. The spindles are hardened and ground and run in bronze boxes which are adjustable for wear. The control unit consists of a cam set rotated by a worm and worm-wheel. The rotation of the cam set causes the feed-arm to swing from the feed-pipe to the chuck. The piece is held by the feed-arm until the chuck has closed on one end and the tailstock center has entered the piece. The work then commences to rotate and the wheel is brought up quickly to a predetermined point, after which it is moved at the proper rate for grinding for a predetermined distance, held stationary for a number of revolutions of the work and then quickly moved back to the starting position where rotation of the work is stopped. The jaws of the chuck then open and the tailstock center moves back, allowing the work to drop out.

When testing out one of these machines on rolls 3/8 inch in diameter, the rate of grinding was found to be 12.2 rolls per minute. For six hours' operation, allowing time for dressing the wheel, setting the machine, etc., which consumed about 20 per cent of the total time, the production was 3489 rolls.

ALFRED HERBERT No. 5 AUTOMATIC LATHE

Alfred Herbert, Ltd., 54 Dey St., New York City, has recently placed on the market the No. 5 automatic lathe shown in the accompanying illustration. In this machine all operations except chucking are performed automatically. No countershaft is needed, as a single pulley drive is employed. The machine is low and can be set up and controlled from the floor without the use of a platform. Automatic speed and feed changes can be made while the tools are cutting, and no changing of cams is required for any work within the capacity of the machine. The front and back cross-slides may operate separately or simultaneously.

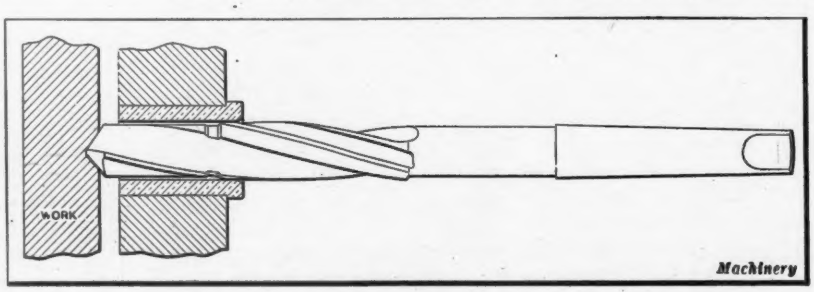
Among the patented features found on this machine are the following: Friction clutches in the head, self-selecting feed motion, instantaneous feed change and three-revolution type of turret feeding and indexing cam. The head is adjustable along the bed for a length of 6 inches, and is of the enclosed type with the gears running in an oil bath. The single pulley runs on ball bearings and drives the head by a friction clutch which can be engaged or disengaged by a hand-lever conveniently located for starting and stopping the machine. The hole through the spindle is 3 5/8 inches in diameter. A flange is provided on the spindle nose for carrying a 15-inch Coventry chuck when this type of chuck is desired.

The main spindle bearings are of white metal and the thrust is taken by a ball thrust bearing. Six spindle speeds are provided, and five ratios of automatic change for each spindle speed are available. The total range of speed is from 14 to 411 revolutions per minute. Provision is made for stopping the spindle automatically at any instant, thus permitting the tools to be withdrawn without leaving spiral markings on the work. After stopping a sufficient length of time to permit the tool to be withdrawn from the work, the spindle is automatically started as the next tool comes into position.

The turret slide has a working stroke of 15 inches; it is indexed in the extreme back position and is clamped automatically. The turret is square and its flat faces are accurately surfaced. The turret cam is of the drum type driven directly by a worm and worm-wheel. It has two grooves, one for moving the turret slide and the other for indexing. For each complete forward and return movement of the turret, this cam makes three complete turns. The maximum swing over the bed is 18 1/2 inches; the maximum distance from the flange of the spindle to the face of the turret is 34 inches and the minimum distance 15 inches. The speed of the single pulley is 400 revolutions per minute and 7 horsepower is required to drive the machine. The floor space occupied by the machine is 12 feet by 6 feet and the net weight is approximately 8500 pounds.

"FASTFEED" COMBINATION DRILL AND REAMER

In the accompanying illustration there is shown a combination drill and reamer, which is a recent product of the Fastfeed Drill & Tool Corporation, Toledo, Ohio. The drill is made 0.010 to 0.015 inch smaller than the reamer, and it is guided by the reamer entering the bushing before the drill starts cutting. The reamer can be resharpened in the same manner as a standard machine reamer. The bushing should be made 0.0005 inch over the reamer size, and the reamer should enter the bushing approximately 3/8 inch before the drill starts cutting. A four-lipped spiral fluted

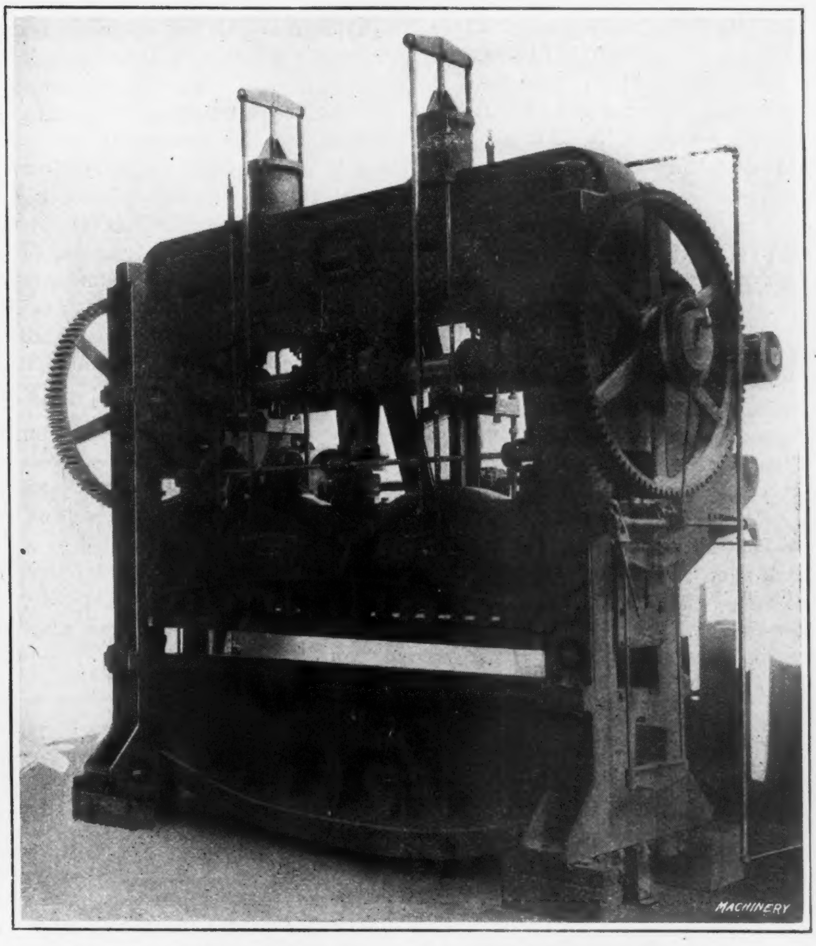


Combination Drill and Reamer made by the Fastfeed Drill & Tool Corporation

reamer is employed, which assures a good clean cut. Features of this tool will be made sufficiently apparent from the illustration without requiring a detailed description. It is at present made in thirty-three sizes, covering a range of reamer diameters from 0.500 to 1.500 inches, and a range of drill diameters from 0.485 to 1.485 inches. The small sized tool has a reamer 2⅜ inches long, and a drill ⅞ inch long, while the large size tool has a reamer 4⅜ inches long and a drill 2⅜ inches long.

WILLIAMS, WHITE POWER PRESSES

Heavy bending, blanking, pressing, shearing, multiple punching, group punching, and similar operations are efficiently performed on power presses of the tie-rod type of construction, if the quantities of work to be handled are sufficient to earn a satisfactory rate on the investment in a press having sufficient capacity to accommodate pieces of large dimensions. It is stated that an equipment of this kind owes its usefulness to three outstanding features. All gears and other parts of the mechanism are located overhead, so that the work may be placed in and removed from the machine from either the front, back, or either end. For this purpose the side housings are made with ample openings or "windows" between the tie-rods. The table and ram are designed with ample die areas and openings, and T-slots to hold the tools required for handling various jobs. All vertical operating stresses are supported by heavy forged steel tension members which fasten the table housings and bridge tree together, and practically eliminate broken side housings.



Tie-rod Type of Power Press built by Williams, White & Co.

Williams, White & Co., Moline, Ill., have recently added to their line two large tie-rod presses of 500 and 800 tons capacity. These machines are for use in blanking out side rails for motor vehicle frames, the smaller machine being used for blanking side rails for passenger cars while the larger one is used to blank side rails for trucks. These machines have been designed along similar lines and general features of their construction conform to standard practice of the firm by which they were built.

Adjustment of the die space is accomplished by screws in the pitmans, which are operated through worm-gearing by an independent motor mounted on the ram. The hold-downs or strippers are made of steel with a T-slot in the face of each for the attachment of special shaped contact fingers. They are operated by cams on the main crank-shaft. Four T-slots are provided in the table, and there is an opening 6 inches wide in the center, which extends the full length of the machine. There are five T-slots in the ram. An ample operating surface has been provided for the friction clutch, and each machine has an automatic stop and brake. All gears are made of steel and a twin type of drive is employed with cut tooth driving gears and pinions at each end of the main shaft. This arrangement equalizes the drive and eliminates torsional lag. An automatic die knock-out connected to the ram and operated by it strips the work from the dies.

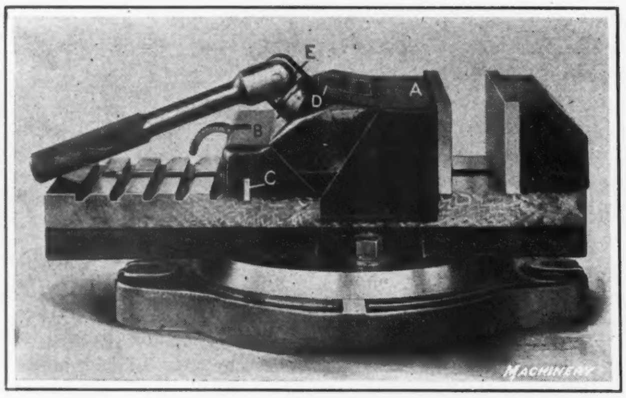
NELSON QUICK-ACTING MILLING MACHINE VISE

The following description deals with a milling machine vise recently placed on the market by the Nelson Tool & Machine Co., Inc., 82-88 Llewellyn Ave., Bloomfield, N. J. The distinguishing characteristics of this vise are its rapid clamping action and ample holding power. These results are accomplished by a rather novel construction of the movable jaw and of the clamping medium employed to actuate it.

Referring to the accompanying illustration, the movable jaw *A* is connected to a latch block *B* by two pins, on each of which a coil spring is carried for exerting tension against the force applied on the movable jaw during the operation of the vise. A lug on the seat of the latch block fits in a groove in the vise bed, thereby furnishing a guide for the block when it is slid along the bed, whenever this adjustment becomes necessary. There are seven transverse slots on the upper surface of the bed, which are located at ⅝ inch intervals, to enable the vise to be readily set for holding any piece of work within its range, by simply engaging the lower part of latch *C* in one of these slots. When the vise is in use, the latch is held in the slot by two light coil springs, so that it becomes necessary to lift the latch from its slot when increasing the opening of the jaws an additional ⅝ inch. For convenience in doing this it is evident that the latch has a handle provided for the purpose.

The angular surface on the movable jaw inclines 55 degrees from the horizontal and the corresponding surface of the latch block, at a 45-degree angle. A steel wedge *D* is the actuating medium by means of which the movable jaw is advanced against the work. This wedge has angular surfaces to conform to those of the latch block and of the jaw, and carries the operating screw *E* which extends through the movable jaw and into a square threaded nut under the jaw. It will thus be seen that by operating the screw by means of the pivoted handle, a wedge action is produced, which exerts a pressure on the movable jaw fifty times greater than that exerted by the hand-operating screw. The manipulation of this hand-operated screw enables the movable jaw to be advanced ⅝ inch (the spacing of the trans-

verse slot in the bed) before it becomes necessary to change the position of the latch. The nut in which the operating screw engages is integral with the movable jaw. This nut does not serve as a guide for the jaw, although it extends into the slot in the vise bed, similarly to the guiding lug on latch block *B*. The movable jaw is guided by means of the flange-like extension of its sides.



Wedge-operated Milling Machine Vise built by the Nelson Tool & Machine Co.

The jaws have hardened and ground steel faces with plain gripping surfaces and are attached to their respective castings by machine screws. The base of the vise is graduated in degrees, and is attached to the milling machine table by bolts in the regular manner. This tool may be furnished either with or without the swiveling feature shown in the illustration. The vise is made in two sizes: Size No. 1 has jaws 6 inches in width by 2 inches in depth, and will open 5¾ inches; size No. 2 has jaws 4 inches wide by 1½ inches deep and has a maximum capacity of 4 inches.

NEWTON CONTINUOUS MILLING MACHINE

For the performance of many classes of repetition work in the manufacture of duplicate parts, rates of output are increased through applying the so-called continuous principle of machining. This result is obtained as a result of provision made by the machine tool designer for reducing non-productive time of both the machine and its operator; and this principle has been successfully employed in the construction of various types of machine tools. Figs. 1 and 2 show opposite sides of a continuous rotary milling machine, which is a recent product of the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., and Figs. 4 to 7, inclusive, show close-up views of the milling cutters and fixtures for the milling of pieces shown in Fig. 3.

It will be apparent that the column and the base of this milling machine are cast integral to afford ample rigidity. Provision has been made for mounting various types of work-holding devices on the circular table, so that the machine is adapted for handling quite a wide range of work. Also, the table is adjustable on the base, making it possible to properly position the work-holding fixtures in relation to the milling cutters. By this means the radius from the center of rotation of the table to the point of cutting may be held down, and the milling cutters may be made of the smallest suitable diameter for the work which they are required to perform. Bearing in mind the fact that the rate of production is largely controlled by the number of pieces of work that can be handled per revolution of the table, the advantage of properly setting up the work on the table will be readily appreciated. It is essential for the pieces that are to be milled to be set up with the least possible space between them, and this statement applies regardless of whether the spaces are rectangular or wedge shaped, due to the pieces being set up on the table at an angle to each other. Machines of this type are built with tables 24, 36, and 48 inches in diameter on their working surface, which is surrounded by a pan for collecting the coolant that is used in milling steel.

Arrangement of the Feed Mechanism

In operating one of these Newton continuous rotary milling machines, the spindles revolve but otherwise remain in a stationary position, while the table revolves to provide for feeding the work under the milling cutters. Rotative movement of the table is controlled by a fixed feed mechanism so that there is no danger of the operator increasing or decreasing the production of the machine. The employment of a specified rate of table rotation also requires a given number of work-holding fixtures to pass the loading station per

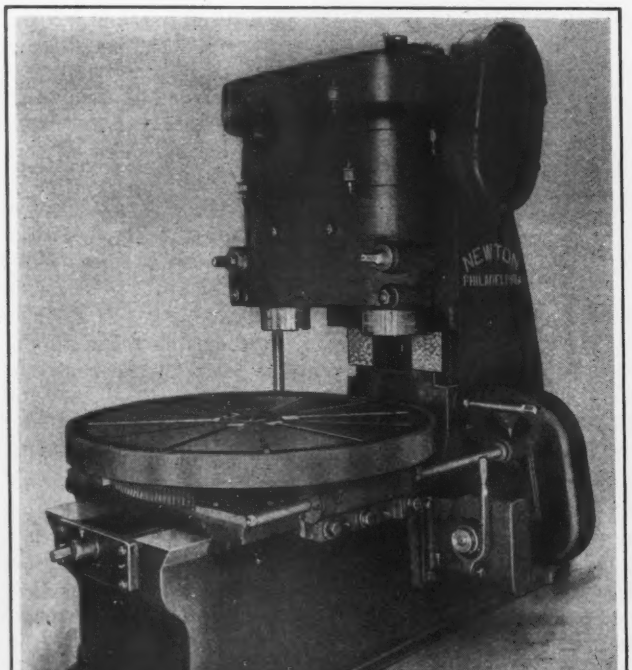


Fig. 1. Continuous Rotary Miller built by the Newton Machine Tool Works

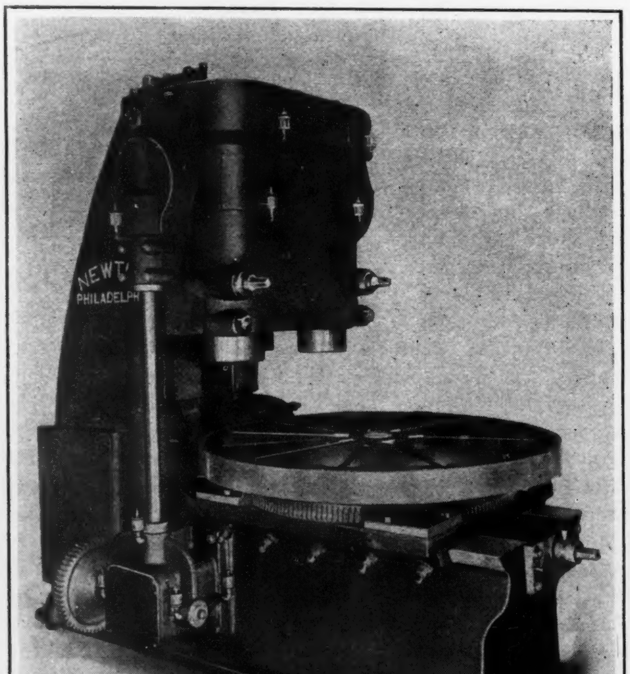


Fig. 2. View of Opposite Side of the Newton Continuous Rotary Milling Machine

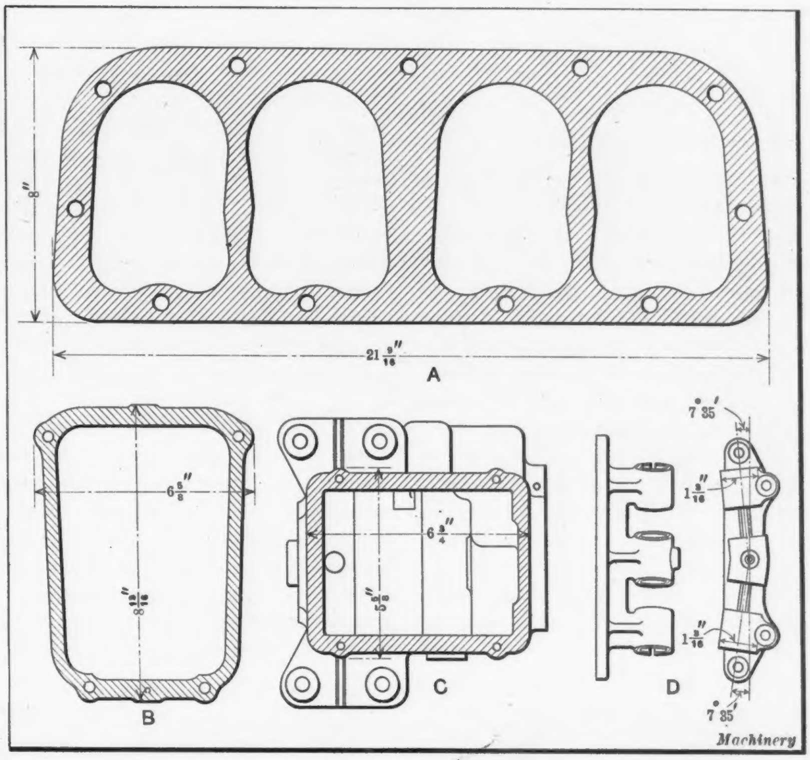


Fig. 3. Examples of Work done on Newton Continuous Rotary Miller. Shaded Areas indicate Milled Surfaces

hour, and failure of the operator to produce the stipulated number of pieces of work should immediately lead to investigation concerning the cause. While the feed mechanism normally remains fixed, provision is made for allowing authorized employes to increase or decrease the rate of table rotation.

Arrangement of the Speed Mechanism

Changes of spindle speed are controlled in the same manner as adjustments of the rate of feed. Attention is drawn to the fact that power is transmitted to the spindles by means of worms and worm-wheels of a type which is extensively used in machinery built by the Newton Machine Tool Works. It will be seen that the head which carries the spindles is made adjustable on the column, which is a necessary feature of this type of machine, in order that the work-holding devices may be set as low on the table as the form of the work will permit. Adjustments are accomplished by lowering the spindle into the correct position for the work. This arrangement reduces the extension or overhang of the spindle, and also permits the work-holding fixture to be made as compact as possible.

Advantage of Dividing the Work between Roughing and Finishing Cutters

It will be seen that the spindle head is equipped with two spindles, each of which is individually adjustable to provide for setting the cutters to gages. Roughing cuts are taken by the left-hand spindle, and finishing cuts by the right-hand spindle. On the machine with a 48-inch table, the distance between the spindle centers is 22½ inches, and on the machine with a 24-inch table, the spindles are located 13 inches from center to center. On the largest machines, ample capacity is provided to enable large pieces of work to be passed over by the roughing cutter before the finishing operation is started on the same piece. It is claimed by the builders of these machines that continuous rotary milling is one of the most accurate methods of machining parts in quantities, because any variation in the work done by the roughing cutter, due to inequality in the size and physical properties of the castings, is absorbed while performing the finishing operation.

Owing to the small amount of work to be performed by the finishing cutter, both the accuracy and perfection of workmanship of the product are said to be maintained at a high standard, without requiring the cutters to be ground at frequent intervals. Also, the ability of the finishing cutter to hold the required degree of accuracy, while taking a light cut, makes it possible to run the machine at much higher cutting speeds and feeds than would otherwise be practicable. It is stated that pieces measuring 6 by 20 inches on the milled surface have frequently been taken out of the work-holding fixture and laid on the surface plate, where it was found that they would hold six tissue paper "feelers," and also that it was impossible at any point to enter a thickness gage measuring 0.0015 inch. These tests indicate that not only is a high finish produced, but that there is no warping of the casting or digging in of the cutter on the leading side.

To those who make a careful study of the operation of one of these machines, it will be apparent that the manner in which the work presents itself to the cutters is one of the big factors in making possible the high rates of spindle speed and table feed that are commonly employed. As the table revolves to feed the work under the cutters, each casting to be milled presents a constantly changing angle to the cutters, thereby affording a shearing action and avoid-

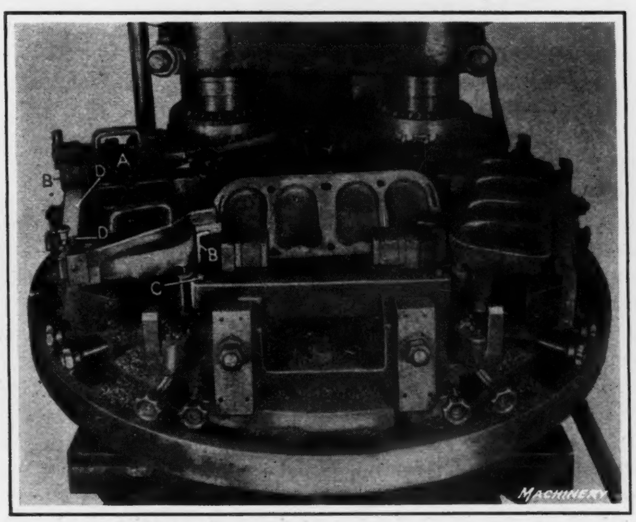


Fig. 4. Newton Continuous Rotary Miller machining Automobile Engine Cylinder Heads

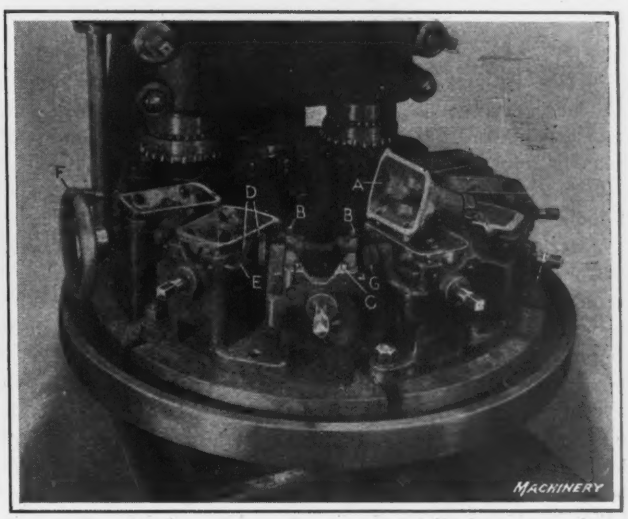


Fig. 5. Milling Automobile Gear-case Covers on Newton Continuous Rotary Miller

ing the presentation of a large contact area to the milling cutter teeth. All driving gears in the machine are made of hardened steel and they are mounted in fully enclosed cases, so that they may be run in oil.

Milling Automobile Engine Cylinder Heads

Fig. 4 shows one of the Newton machines equipped for milling automobile engine cylinder heads, which are located from the rough cast surface by means of a gage *A*. Each casting is placed in the work-holding fixture after which the gage is set in position over it, and then the location of the casting is adjusted to the gage, which locates it from the top of the combustion chamber, in order that the volume and combustion area of this chamber may be held uniform for all castings. The way in which this result is accomplished is as follows: Gage *A* is provided with lugs that engage hooks *B* on the work-holding fixture, and in the bed of the fixture there are spring plungers *C* which apply sufficient thrust against the work so that the rough cast inside surface of the combustion chamber is pushed up firmly against the under side of gage *A*.

After this result has been accomplished, two straps *D* are tightened up to provide for securely holding the work in place, after which the setting gage *A* is removed, so that the casting may be fed under the milling cutters to provide for taking a roughing and a finishing cut, with the result that the under side of the cylinder head is faced off to leave a combustion chamber of the required capacity. At *A* in Fig. 3 the dimensions and form of the area to be milled are illustrated, and on this job the rate of production obtained is 30 cylinder heads per hour.

Milling Automobile Gear-case Covers

In Fig. 5 there is illustrated the equipment of a Newton continuous rotary miller used for milling automobile gear-case covers, and at *B* in Fig. 3 the shaded area shows the surface that has to be milled on these castings. Attention is called to the way in which these pieces are set up around the circumference of the table, with the result that there is practically no loss of time while the cutters are leaving one piece and starting work on the next piece. On this job the rate of production is 120 castings per hour. In this case, the method of holding the work in the fixture is quite simple, as will be realized by referring to the station of the milling machine table where casting *A* has been removed from the fixture. It will be noticed that the surface to be milled is the under side of a flange that surrounds the open end of the casting. As this flange is not very thick, there would be danger of springing the work out of shape by the pressure of the cut, unless special precautions were taken to avoid difficulty of that kind.

At the back of the fixture there are two screw heads *B* that support the work from the under side of the flange; and at the front of the fixture there are two spring plungers *C* which rise into contact with the work, after which the plungers are secured in place by tightening up the binding screw. At each side of the fixture it will be noticed that there are two leaves *D* which are supported by spiral springs *E*, these leaves affording support at each side of the casting to the flange that is to be face-milled. After each casting has been set up in the fixture in this manner, screws *F* and *G* are tightened to provide for clamping it securely in place for performing the milling operation. In Figs. 4 and 5 a good idea is given in regard to the large diameters of the milling machine spindles as compared with the cutters.

Milling Operations on Automobile Transmission Cases

The milling operation to be performed on automobile transmission gear-cases of the form shown in process of manufacture in Fig. 6 consists of facing the area shown in cross-section at *C* in Fig. 3. Fig. 6 is of especial interest because it gives a definite idea of the way in which Newton continuous rotary milling machines are being employed to obtain high rates of production in handling repetition work. It will be seen that gravity carriers are arranged to bring the work to the machines and to carry away the milled castings, the actual rate of output being from 100 to 125 transmission gear-cases per hour.

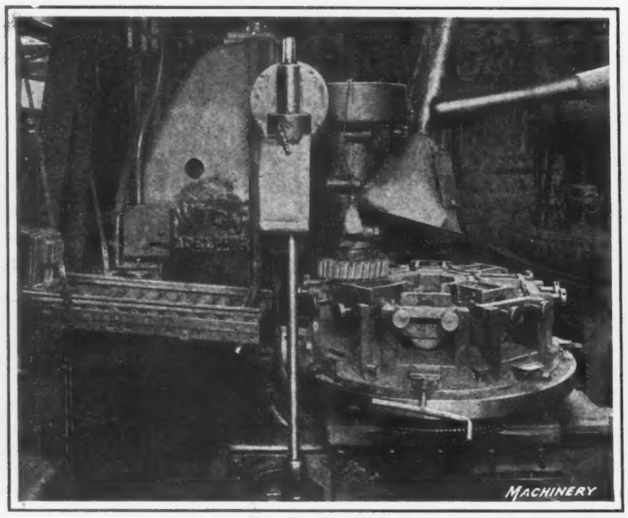


Fig. 6. Newton Continuous Rotary Miller machining Automobile Transmission Gear-cases

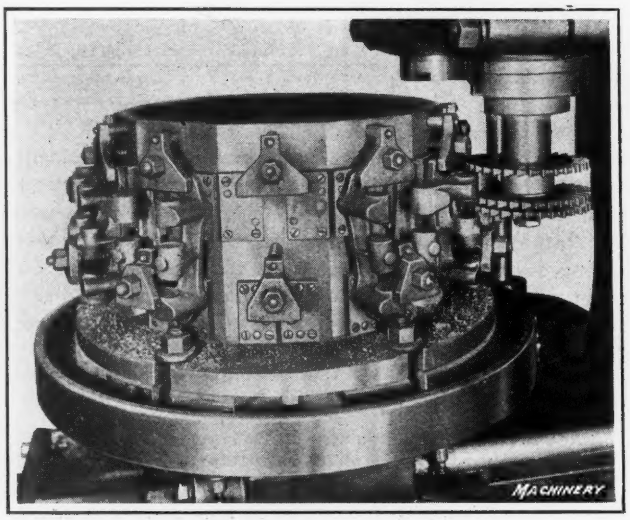


Fig. 7. Machining Angular Bracket Faces on Newton Continuous Rotary Miller

Method of Facing Bracket Bosses

Fig. 7 illustrates the equipment of a Newton continuous rotary milling machine which has been worked out along essentially different lines from those which have already been described and illustrated in this article. In the present case, the machine is employed for facing brackets with straddle-milling cutters, the work done on the machine being indicated at *D* in Fig. 3. Here it will be seen that there are six faces to be milled, three of which are parallel to each other, while the three remaining faces are also parallel to each other. As a result, it will be apparent that two operations are required to complete this job, and Fig. 7 shows a gang of three cutters that are used to simultaneously perform the required operation on three of the faces. With a feed of 4 inches per minute, a production of 30 brackets per hour is obtained.

With the preceding statement concerning the nature of the work to be handled on these castings, reference to the unloaded station on the milling machine table and to the station on which a casting is set up ready for milling, together with the detailed view of the work shown in Fig. 3, will show the method of procedure in handling this job without requiring more than a brief description. In Fig. 3

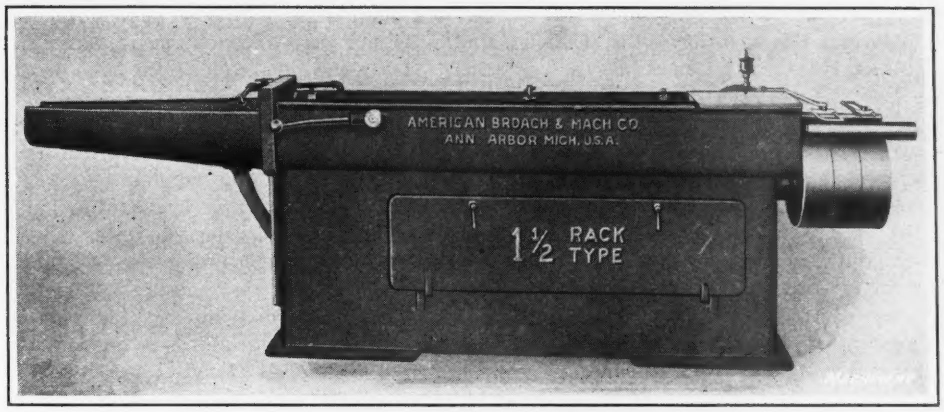


Fig. 1. American No. 1½ Rack-operated Broaching Machine

it will be seen that there are four holes drilled in the work, and these have already been finished at the time the work comes to the milling machine, so that pilots on the vertical faces of the work-holding fixture may enter these holes to provide for locating the work to obtain the required angular positions for the milled faces of the bracket. Then the work is secured in place on the fixture by bolting the straps back in place. It will be seen that two bracket castings are carried on each face of the milling fixture.

AMERICAN BROACHING MACHINE

The American Broach & Machine Co., Ann Arbor, Mich., has recently brought out the No. 1½ rack type broaching machine illustrated in Fig. 1. The manufacturers state that this machine is capable of more rapid operation than their screw-operated type of broaching machine. The main driving shaft is hardened and ground and is keyed to a special bronze worm-gear. The worm and worm-wheel shown in Fig. 3 are encased and run in grease. The main driving pinion is hardened and engages the D-shaped rack.

The machine is provided with a high-speed return motion which operates at double the speed of the cutting stroke. The loose pulleys which are shown in Fig. 2 are mounted on Hyatt roller bearings. There are no clutches employed on this machine, but an automatic brake band is provided which operates immediately when the sliding head reaches either end of the stroke. This brake absorbs the momentum of the driving mechanism and enables the travel of the table to be accurately controlled by the automatic stops.

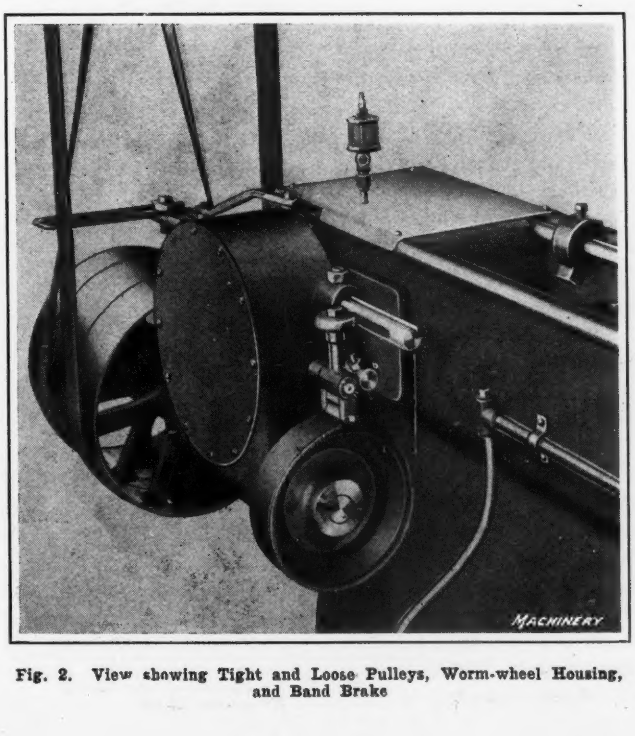


Fig. 2. View showing Tight and Loose Pulleys, Worm-wheel Housing, and Band Brake

When using a broach 4 feet in length, the time required for the cutting stroke and the return of the broach to its starting position is from 28 to 30 seconds. The machine has a cabinet base which is fitted with shelves. The face of the base is finished within 2 inches of the foot and has two machined T-slots for attaching boring fixtures, an oil trough or other attachments. The oil pump, which requires no priming, is furnished as standard equipment, and a detachable oil trough is also furnished with the machine. It is claimed that the life of the rack-operated machine is lengthened because of freedom from twisting action.

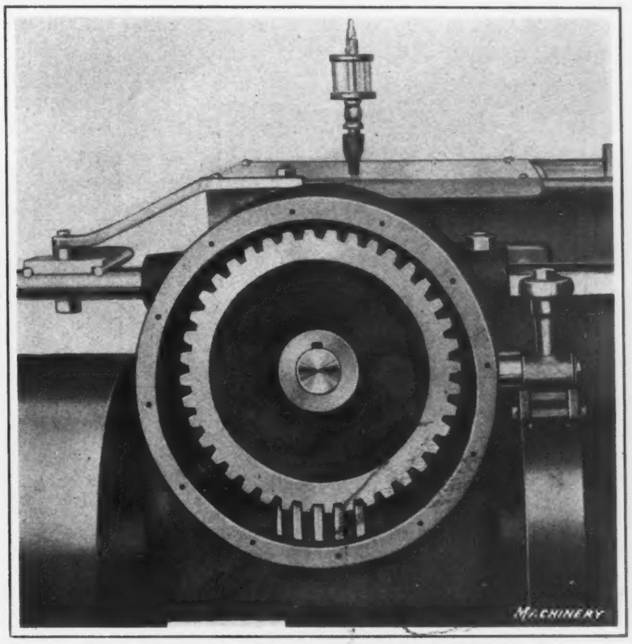


Fig. 3. View showing Cap removed from Worm-wheel Housing

WESTINGHOUSE ELECTRIC ARC FURNACE REGULATOR

High electrode operating speed and close precision of regulation are the two important features of the electric arc-furnace regulator just placed on the market by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. The ability of this regulator to incorporate high speed with a narrow current zone is due to the fact that the electrode speed varies all the way from full to zero as the regulated current approaches its normal value. In other words, within certain limits the restoring speed is approximately proportional to the amount that the current in the electrode deviates from normal. This permits the greatest possible electrode speed for a given current variation. This feature is particularly appreciated during the melt-down of cold scrap. For small variations in current the speed is slow enough to prevent continuous breaking of the arc, and at the same time, when the solid metal begins to cave into the pools of molten metal under the electrodes, sufficient speed is available to permit the regulator to extricate the electrode before the time relay allows the breaker to trip.

When the current is turned on in a furnace charged with cold scrap, it is only necessary to throw the regulator control to the automatic position. Regardless of the position of the electrodes at this time, the regulator will allow each one to run down at full speed until it touches the steel, when complete automatic regulation will commence. It is ab-

solutely impossible for an electrode to get into the steel, and practically no attention is required from the operator. One very important feature of the regulator is its utilization of the arc voltage as well as the arc current to control the motors. Under-voltage relay trips on the control circuits are unnecessary. With any purely current-actuated device, it is said to be impossible to maintain equal arc lengths in furnaces using two or more electrodes, particularly when operating at reduced power. In this regulator, the arc voltage and the electrode currents are maintained balanced. The voltage coils also make the control of each electrode independent of the others. In fact, one electrode may be entirely withdrawn without disturbing any of the others. In a regulator dependent upon current control exclusively, any movement of one of the electrodes causes the elements of all other electrodes to change their positions.

GRISCOM-RUSSELL OIL HEATER

The Griscom-Russell Co., 90 West St., New York City, has recently placed on the market a new oil heater unit of the straight tube type. This heater is intended to supplement the line of coil heaters made by this firm, and is known as the G-R oil heater. As shown in the accompanying illustration, it is designed for the preheating of fuel oil before it goes to the burner for the purpose of insuring complete atomization of the oil and perfect combustion under boilers or in furnaces. The oil is pumped through the tubes, and steam at a pressure of 250 pounds per square inch in the shell serves as the heating medium.

The shell of the heater is constructed of wrought steel welded to the steel tube-plates. The tubes are of seamless drawn steel and their ends are expanded in the steel plates at either end. The heaters are made in twelve sizes, the smallest size No. 9 has an inside diameter of shell of 4 inches, a length of 54⅞ inches, and a weight of approximately 150 pounds. The largest heater No. 432 has an inside diameter of shell of 21 inches, an over-all length of 69⅜ inches, and weighs approximately 3100 pounds.

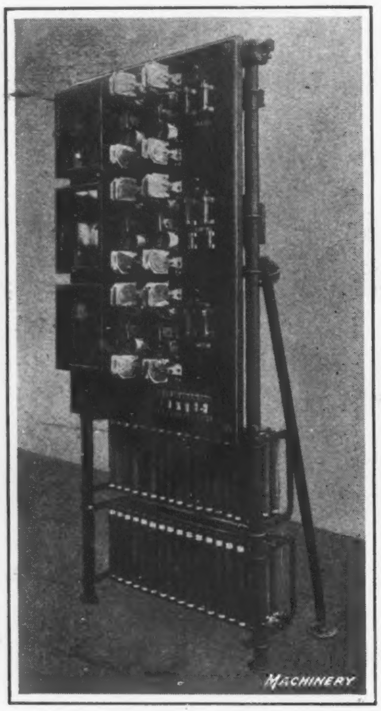
BARKER WRENCHLESS CHUCK

In the accompanying illustration there is shown the Barker wrenchless chuck which is made according to the design of W. A. Barker and manufactured by the Foster Machine Co., Elkhart, Ind. Its purpose is to obtain rapidity and ease of operation. The fundamental idea involved in its construction is to transfer movement from a hand-lever equally to each of the jaws regardless of whether the chuck is revolving or at rest. This movement is accomplished by means of the combination of a cam and trunnion levers and a planetary gear system. A slight pressure on the hand-lever is sufficient to release the work from the jaws.

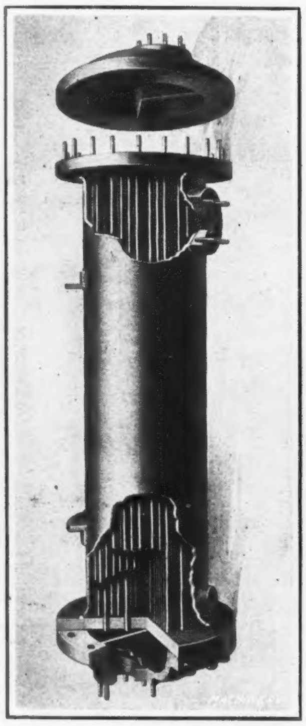
This chuck provides a quick and effective means of gripping the work and affords ample jaw pressure. Accurate rechucking may be obtained, due to freedom from wear on the cam surfaces owing to their rolling action on the trunnion levers. Should it happen that unequal wear occurs on the cam surfaces, the resultant eccentricity of the jaws will be reduced to one-quarter of the wear owing to the ratio of the trunnion levers.

A sub-committee of the Committee on Science and the Arts of the Franklin Institute of the state of Pennsylvania, after fully investigating the merits of the Barker wrenchless chuck recommended the award of the Howard N. Potts gold medal to the inventor of this device, Wendell Addison Barker, in recognition of the improvements embodied in the chuck and its successful use on a large scale. This award was made on July 22.

In this connection a test made at the Fairbanks Co. in Philadelphia showed the following results: A piece of 35-point carbon steel forging 7 inches in diameter by 4½ inches long with a 3⅞-inch hole ⅜ inch out of center was mounted in a 12-inch, three-jaw Barker chuck. The hand-lever was tightly pulled down. Each jaw had a gripping surface of ½ inch. Three cuts were made at the same time with a feed of 0.008 inch



Arc Furnace Regulator made by the Westinghouse Electric & Mfg. Co. East Pittsburg, Pa.



Griscom-Russell Oil Heater designed for preheating Fuel Oil

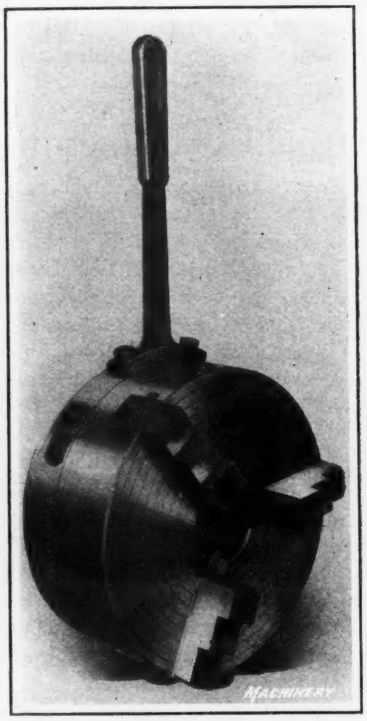


Fig. 1. Barker Wrenchless Chuck manufactured by the Foster Machine Co.

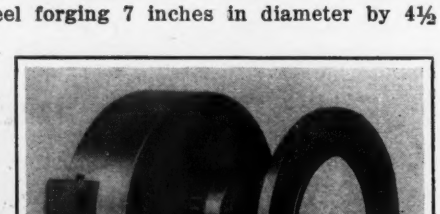
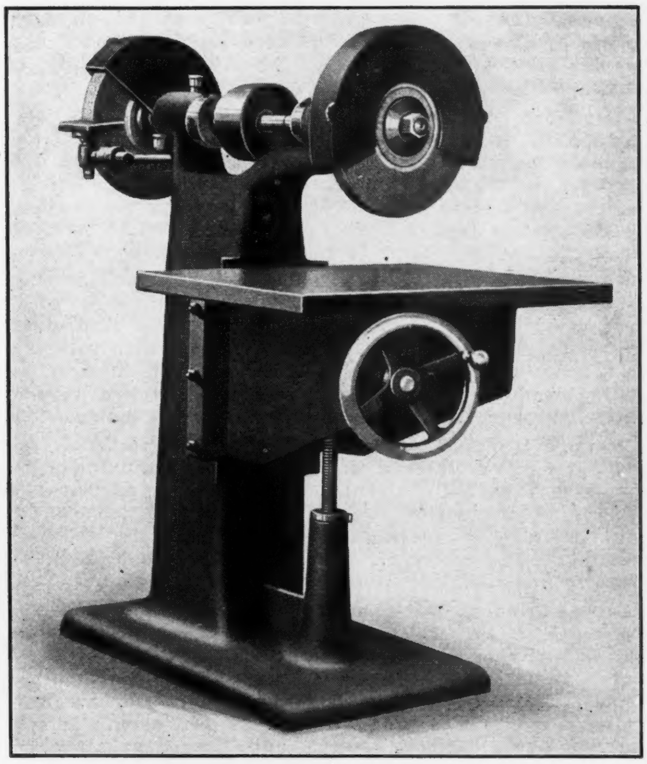


Fig. 2. Mechanism of the Barker Wrenchless Chuck

toward the headstock, at 30 revolutions per minute. A cut of ⅜ inch in depth was made by the first tool; a second tool at 1 inch distance from the cutting edge of the first tool made a cut of ½ inch in depth; the third tool cut the hole to 5⅝ inches in diameter, cutting ¼ inch on one side and ⅝ inch on the other. The chuck held the work without difficulty.

COMBINATION SURFACE AND PLAIN GRINDER

The Johnson & Biddle Tool Co., 312-314 N. Main St., Elkhart, Ind., is building the combination surface and plain grinding machine shown in the accompanying illustration. This machine weighs 600 pounds and has a capacity of 12 inches from wheel to column. The maximum distance from the wheel to the surface of the table is 10½ inches. Two 12-inch by 1¼-inch wheels are mounted on the spindle which

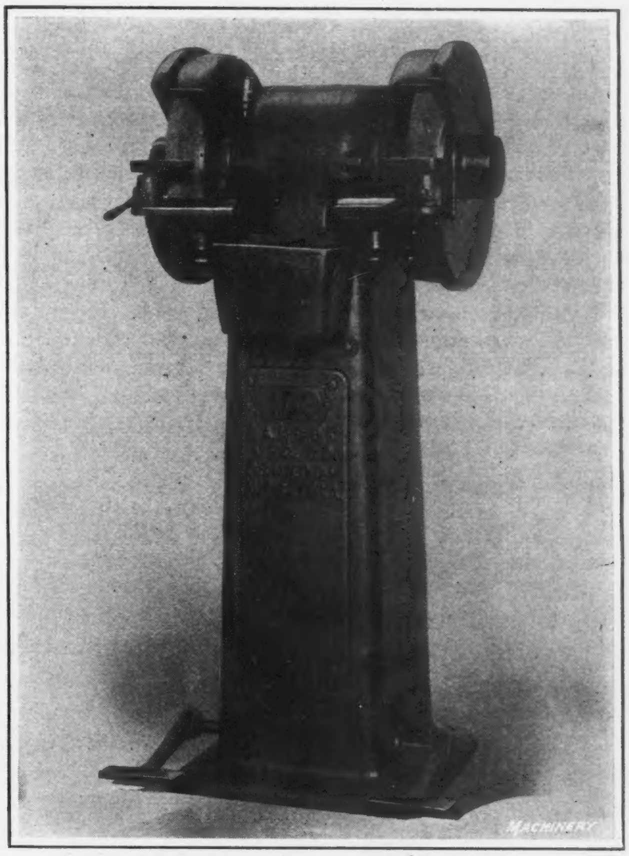


Combination Surface and Plain Grinder made by the Johnson & Biddle Tool Co.

is provided with long bronze bearings that are adjustable for wear and which can be easily replaced when it becomes necessary. The table is raised and lowered by means of the graduated handwheel.

RANSOM TOOL GRINDER

The Ransom Mfg. Co., Oshkosh, Wis., has added to its line of grinding machines a No. 109 ball-bearing motor-driven tool grinder. This machine is equipped with a ¾-horsepower General Electric induction motor, suitable for operation on sixty-cycle two- or three-phase current of any voltage. Two 12- by 1-inch wheels used on the machine are furnished with guards, and the spindle is carried by self-aligning ball bearings mounted in a manner that provides for the exclusion of dirt. A quick make and break oil switch controlled by pedals enables the machine to be started by a light pressure of the foot, these pedals being conveniently located at the ends of the machine, and arranged in such a manner that when the foot pressure is released, the machine stops automatically. This prevents a waste of power by having the machine running when it is not in use. The

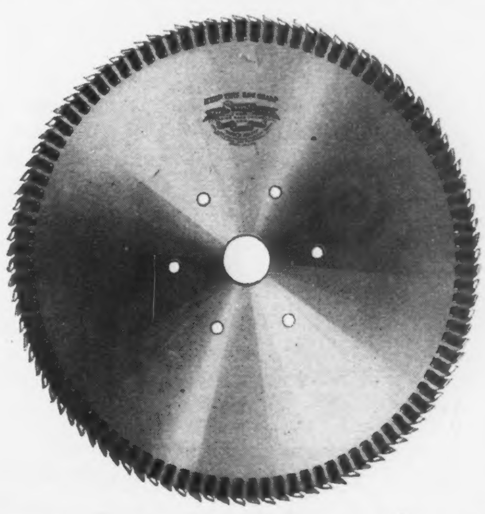


No. 109 Tool Grinder built by the Ransom Mfg. Co.

grinder occupies a floor space of 17 by 17 inches, and its weight, as shown in the illustration, is 480 pounds.

SIMONDS INSERTED-TOOTH METAL SAW

The inserted-tooth metal saw shown in the accompanying illustration has been recently placed on the market by the Simonds Mfg. Co., Fitchburg, Mass. This saw is designated as No. 000, and was especially designed to meet the requirements for cutting structural iron, I-beams, channels, and stock having thin walls, which could not be as efficiently cut with saws of ordinary design in which the pitch or spacing of the teeth is too coarse. This new saw, having closely spaced teeth, provides smooth running qualities and

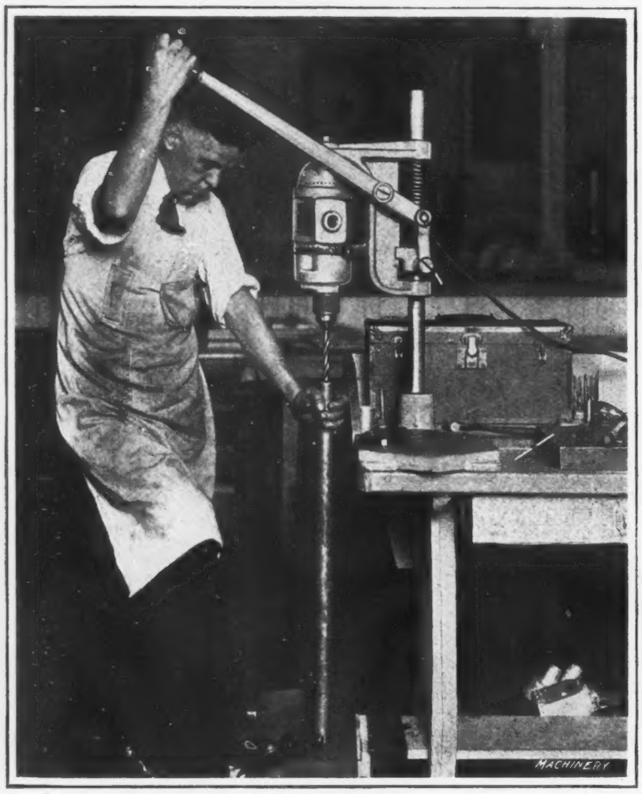


Simonds No. 000 Metal Saw for cutting Structural Iron and Stock having Thin Walls

eliminates chatter. The saws are made in sizes from 10 inches in diameter with a kerf of ¼ inch and a maximum of 40 teeth up to 40 inches in diameter with a 15/32-inch kerf and a maximum of 210 teeth.

BENCH DRILLING STAND FOR PORTABLE ELECTRIC DRILLS

A bench drilling stand designed for supporting portable electric drills has recently been placed on the market by the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md. With this stand, the Black & Decker portable drills of the pistol grip and trigger switch type are readily adapted for use as a drilling machine. The bracket carrying the drill can be raised or lowered on the vertical column, and it is secured in any desired position by means of a split collar and clamping screw. The drill may be swung clear of the base for performing drilling operations such as those that are required in assembling ring gears on automobile axles, drilling the ends of shafts, and other work which is too long to be drilled on the bench. Both vertical and horizontal adjustment is secured by means of the clamping screws, and the drill can be swung through a complete circle about the vertical stand.



Black & Decker Bench Drilling Stand

The feed-lever has a leverage ratio of 6 to 1, so that a pressure of 100 pounds applied to the handle will feed the drill into the work under a pressure of 600 pounds. The base has six tapped holes to accommodate ½-inch studs which may be used to clamp the work in place. The base is also provided with four holes for fastening the stand to the bench. The stand is shipped complete with an adapter block to take various different sizes and types of Black & Decker drills. The dimensions of the stand are: Height, 30 inches; vertical adjustment of drill, 12 inches; distance from center of drill spindle to circumference of vertical column, 7 inches; vertical travel of drill when operated by feed-lever, 4 inches. The net weight of the machine is 70 pounds.

NEW MACHINERY AND TOOLS NOTES

Oil Filtering and Sterlizing System: S. F. Bowser & Co., Fort Wayne, Ind. A filter and sterilizer which automatically removes foreign matter and sterilizes the cutting oils.

Knurling Tool: Newman Mfg. Co., 717 Sycamore St., Cincinnati, Ohio. A knurling tool having upper and lower knurling wheels which bear on opposite sides of the work so that the tool centers automatically.

Tool Grinder: United Sates Tool Co., 3160 W. 106th St., Cincinnati, Ohio. A self-contained motor-driven tool grinder equipped with a five-horsepower direct-current, adjustable-speed, 230-volt motor which gives a speed of from 1120 to 1600 revolutions per minute.

Light Fixture Cleaner: Associated Engineers Co., Chicago, Ill. A device which cleans the lamp and shade of electric lamps each time the light is turned on or off by means of two wiping blades, one of which rotates against the interior of the reflector and the other against the lamp bulb.

Electric Melting Pot: Cutler-Hammer Mfg. Co., 50 Church St., New York City. An electrically heated melting pot for melting lead, tin, solder, babbitt, and other soft metals, which is made in 10- and 25-pound portable sizes. A bench type melting pot is also made in three sizes of 50, 100, and 150 pounds capacity.

Steel Bench Legs: Angle Steel Stool Co., Otsego, Mich. Shop bench legs known as "Ot-Steel" bench legs, which are made in various heights and styles. They are so designed that boards of any width may be used for the bench, or if desired heavy planks can be used along the front edge where the wear is most severe.

Optical Pyrometer: Rhode Laboratory Supply Co., 17 Madison Ave., New York City. A portable optical pyrometer for measuring high temperatures, known as the "Wedge" optical pyrometer, which can be used for determining any temperature above 525 degrees C. The actual temperature is read on a scale attached to the side of the instrument.

Calorizor: Mahr Mfg. Co., Minneapolis, Minn. A combination of oil atomizer and gasification and combustion chambers for attachment to industrial furnaces, intended for handling any grade of oil or gas. The machines are built in two types and three sizes having oil consumption capacities for the straight type of 5, 8, or 12 gallons per hour, and for the angle type of 4, 7, or 10 gallons per hour.

Heat-treating Furnace: Advance Furnace & Engineering Co., Springfield, Mass. An automatic "moving-floor" heat-treating furnace in which the material to be treated is carried first through a preheating chamber, which uses the waste gases of the heating chamber, and then through the heating chamber to the outlet of the furnace where it automatically dumps the material into the quenching tank.

Portable Grinding Machine: Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill. A portable grinding machine known as Type 2 UA. This machine can be adapted for either internal or external grinding. Spindle extensions of 5, 10, or 15 inches in length may be attached for internal grinding. The motor is of ¼ horsepower, and the total weight of the machine without equipment is 25 pounds.

Lathe Grinding Attachment: Société pour l'Industrie Mecanique, Basle, Switzerland, with temporary offices established at 2632 Equitable Bldg., 120 Broadway, New York City. An attachment intended chiefly for use on a lathe, which is so arranged as to carry the grinding wheel at any desired angle. It is equipped with its own driving motor and is intended for both external and internal grinding operations.

Furnace: American Metallurgical Corporation, Franklin Trust Bldg., Philadelphia, Pa. An automatic conveyor furnace known as the "Amco," in which the conveying hearth never leaves the furnace. The material is moved along in stages under automatic control. A clock-mechanism timing device can be set so that each step can be varied to meet the requirements for heating such work as crankshafts and camshafts, axles, frames, and tubes.

Melting Furnace: Monarch Engineering & Mfg. Co., Baltimore, Md. A revolving non-crucible melting furnace, which is a direct development of the Simplex type of furnace manufactured by this company. The new model differs in that continuous rotary motion is provided by a motor. The burner is at one end, and the charging and skimming takes place at the other end. The capacity for melting is approximately 750 pounds of metal per hour.

Lift Truck: Stuebing Truck Co., 312 East Court St., Cincinnati, Ohio. A number of improvements have been made in the lift truck manufactured by this company. A new platform stop designed to prevent injury to both goods and truck has been provided, and the hydraulic hoisting device has been equipped with an improved type of valve which permits the truck to be lowered quickly when unloaded, or at a slow speed to insure safety when heavily loaded.

Hand Vise: Newman Mfg. Co., 717 Sycamore St., Cincinnati, Ohio. A hand vise for holding small parts, which is intended especially for the use of tool and jig makers, diesinkers, and machinists. By operating a lever, three gears are rotated in unison which cause the jaws to open or close.

A ball socket in the base permits the vise to be held in any position. The length over all is 9½ inches, the width of jaws 1 inch, and the maximum opening between jaws 2¼ inches.

Machine Vise: Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York City. A three-jaw vise known as the "Fixie," which is designed for holding pieces of irregular shape while machining. This vise is adapted for use in the tool-room as well as for quantity production work. All three jaws can be swiveled independently of each other and can be fixed in the required positions. The device is made in sizes having maximum openings between the jaws of 4, 6, 9, 12, and 18 inches.

Drilling Machine: Silver Mfg. Co., 385 Broadway, Salem, Ohio. A drilling machine which is an improved type of the 20-inch drilling machine previously manufactured by this company, the principal changes being in the style of the frame and an increase in capacity under the spindle. The spindle is provided with a No. 3 Morse taper hole, and the machine can be supplied with either hand or power feed. It can also be furnished with motor drive and in gangs of either two, three, or four spindles.

Belt Sander: C. Mattison Machine Works, Rockford, Ill. A No. 124 automatic-stroke belt sander which is designed to eliminate hand-stroking by the use of a device which automatically moves the sand belt across the surface being sanded. The levers, pulleys, slides, and other parts connected with the shoe, which is mounted on ball bearings, are made of aluminum. Provision is made whereby the motion of the shoe can be controlled by the operator and the pressure changed to suit requirements.

Turret Lathe: Alfred Herbert, Ltd., Coventry, England, with offices at 54 Dey St., New York City. A turret lathe having the cross-slide, turret, and chuck operated hydraulically by means of cylinders and pistons controlled by conveniently located valves. This machine was designed to be operated by men who were disabled in the war. A minimum air pressure of 75 pounds is required to operate the hydraulic cylinders. Individual stops are provided for the turret slide. The swing over the bed is 12 inches, and the machine occupies a floor space of 2 feet by 5 feet 8 inches.

Rivet Forge: Mahr Mfg. Co., Minneapolis, Minn. A No. 16 oil-fuel rivet forge designed for stationary use but furnished with a chain by which it may be lifted and moved by a crane. Either fuel oil or kerosene may be used with the Mahr V-1 type burner. The normal capacity is four hundred, ¾ by 3-inch rivets per hour. Also a No. 12-D hand-portable oil-fuel rivet forge intended especially for shipyard and scaffold work. This forge is composed of two units, the upper containing the forge and tank while the lower unit consists of a stand arranged with tray and rivet bin.

Turret Lathe: W. K. Millholland Machine Co., Indianapolis, Ind. A geared-head turret lathe especially designed for production work. Four spindle speeds are obtainable. Eight feed changes are available through the feed-box, and adjustable stops are provided for automatically tripping the feed. The stops operate automatically for each position of the turret, and when adjusted for the length of each cut may be locked in position. The machine is built in three sizes, Nos. 3, 4, and 6, to swing work 6, 6¾, and 8 inches in diameter over the turret slide and 16½, 18¾, and 21¾ inches, respectively over the bed.

Drill Jig: Automatic Drill Tool Co., 549 W. Washington Blvd., Chicago, Ill. A semi-automatic drill jig sold under the trade name "Adjusto," which has been designed for use in drilling small steel and brass parts up to 1 inch in diameter that are required to be drilled in jigs on high-speed drilling machines. The drill jig automatically clamps the part, trips and returns the spindle of the press when the proper depth is reached, and then unclamps and ejects the part. All these functions including the feeding of the drill are operated by a foot-lever connected with an operating rod in the jig so that the operator's hands are free for handling the parts.

Plate Milling Machine: Marshalltown Mfg. Co., Marshalltown, Iowa. A plate milling machine intended for beveling and squaring the edges of boiler plates up to 1 inch in thickness. Curves can also be milled. A five-horsepower motor mounted on the head drives both the spindle and feed mechanism. Both a friction slip and a quick return are provided in the feed mechanism. An inserted-tooth cutter, 8½ by 2½ inches, is used, the end thrust on the spindle being taken by ball bearings. A spindle traverse of 2 inches provides for milling offset edges. Rollers are provided on both sides of the cutter for holding down the work. The machine is built in four sizes with capacities for milling sheets 8, 12, 16, and 24 feet in length.

Portable Shaper: Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass. A portable shaper designed primarily for drop-forge work such as replaning and truing up drop-hammer die slots, rams, bases, and columns, but which can be used also to replane vees in rams and guides and similar work. The shaper is made in two sizes. The small size is built to plane any part of a surface 48 by 48 inches, and the head has a vertical travel of 8 inches. The large size planer is adapted for planing a surface 66 by 66 inches and the head has a vertical movement of 8 inches. The machines can be adjusted to 15 degrees each side of the vertical and may be set to any required angle horizontally. A three-horsepower electric motor which drives the machine is installed at one end of the bridge.

Countersinking Machine: Langelier Mfg. Co., Arlington, Cranston, R. I. A two-spindle opposed countersinking machine designed for simultaneously countersinking both ends of a pin. Each drilling head has a high-speed spindle driven by a single belt at 2000 revolutions per minute. The spindles run in adjustable phosphor-bronze bearings. The spindle pulleys run on two radial ball bearings mounted on stationary sleeves anchored in the drill head casting, so that pulling strains on the spindle are eliminated. The cutting lubricant flows only when actual countersinking is in progress and is filtered before it returns to the pump for recirculation. The work is released from the jig either by a hand- or a foot-lever, and is held between two jig heads which have beveled bushings adapted for holding pins of various diameters. Drills up to ⅜ inch in diameter can be used, and the machine will handle pieces of a minimum length of 1 5/16 inches and a maximum length of 4½ inches, and minimum and maximum diameters of ⅝ and 15/16 inch, respectively.

* * *

ALUMINUM AUTOMOBILE PISTONS

Aluminum automobile pistons require more careful handling and fitting than cast-iron ones, but there is no doubt that they can be used with satisfaction if the designer and manufacturer observe the following fundamental principles: (1) Careful attention should be given to the oiling system to prevent an excessive amount of oil being fed into the cylinder; (2) the cylinder walls should be finished smooth and round and should be so constructed that they will remain round as they are being worn; (3) the piston, while being finished, should be held within close limits as to the diameter and the clearance allowed when in the cylinder; (4) the piston should have satisfactory bearing surfaces, the wrist-pin bosses should be properly located and supported, and there should be no superfluous ribs or uneven sections to cause distortion.

Aluminum alloys have a greater coefficiency of expansion than cast iron; therefore the maximum size that a piston may reach under operating conditions must be considered, and the size of the piston when cold held accurately to a given figure. The tolerance given the production department should be such as to make the piston smaller rather than larger; however, if the tolerance is too great, a tendency toward piston slap will result. Nevertheless, aluminum pistons can be fitted sufficiently free to allow the running of the engine without piston slap, at any speed within the driving range of the car. Attention is called to the extremely desirable thermal qualities of aluminum pistons. The pistons used in the Liberty engines, when finished, weighed approximately three pounds; if cast-iron pistons had been provided, containing the same capacity for heat conductivity as the three-pound pistons, the cast-iron pistons would have weighed over 22 pounds.

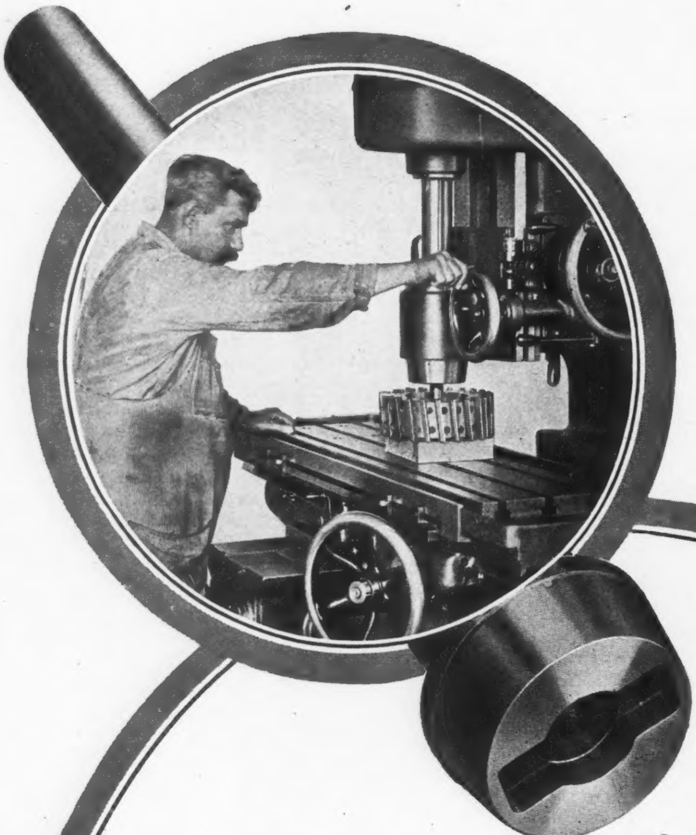
This statement can be quickly checked by the fact that heat conductivity is a question of volume rather than of weight and that aluminum has at least three times the heat conductivity properties of cast iron. A cast-iron piston, therefore, to have the same capacity for heat dissipation as one of aluminum, would have three times the volume of metal, which, if cast iron weighed the same as aluminum, would necessitate a 9-pound piston. Since cast iron weighs over 2½ times more than aluminum, it is obvious that a cast-iron piston having the same thermal qualities, would have weighed more than 22 pounds.

* * *

BRITISH EXHIBITIONS PLANNED AT OLYMPIA

The British Society of Motor Manufacturers and Traders, Ltd., has announced that a commercial vehicle exhibition will be held at Olympia (London) October 15 to 23; an automobile exhibition, November 5 to 13; and an international motor boat and marine and stationary engine exhibition, March 11 to 23, 1921.

Brown & Vertical Milling

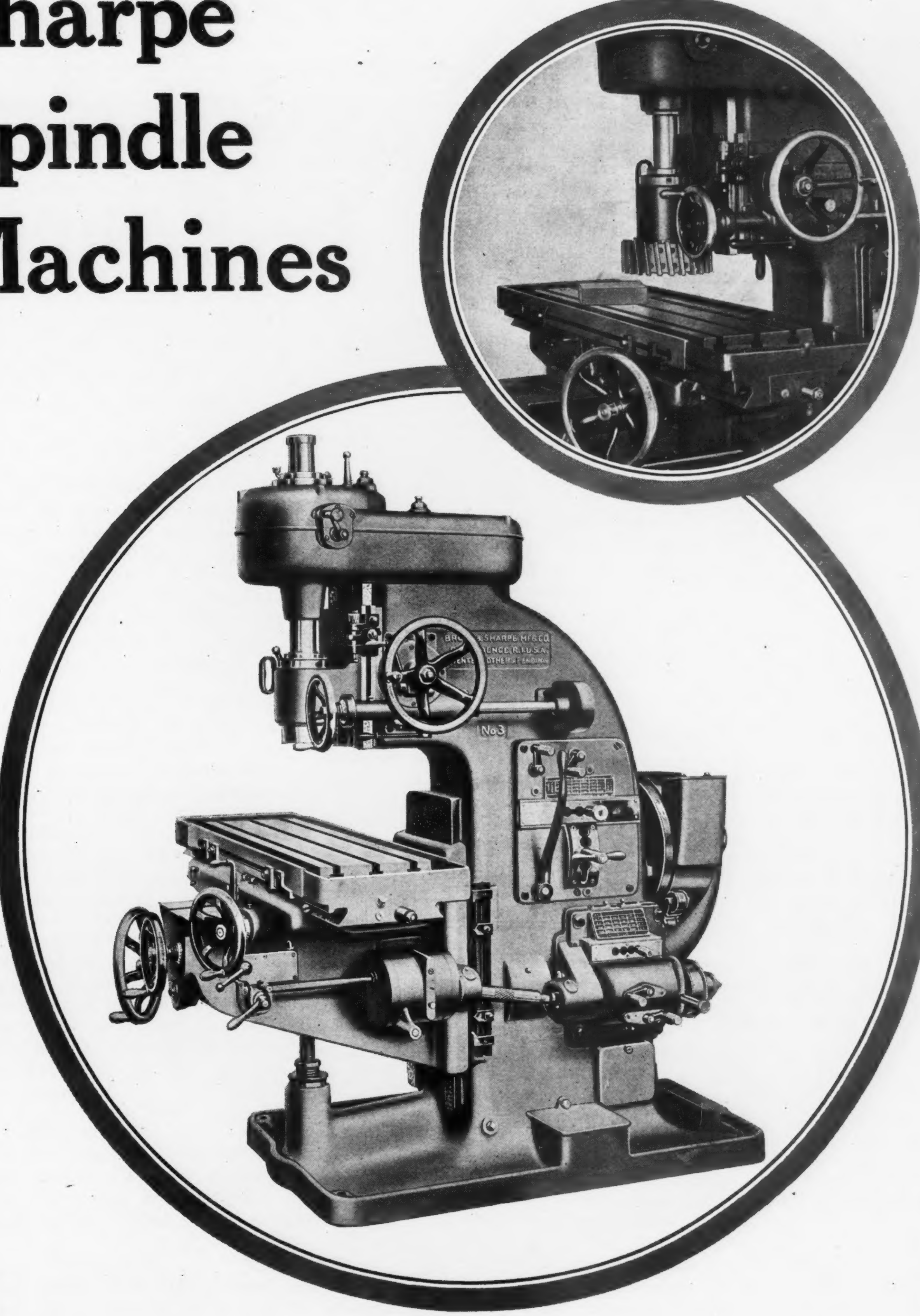


The Taper Nose Spindle

assures a positive cutter drive under all conditions. The front end of spindle is tapered, hardened and ground and has a recess to receive cutter driver and clutch on arbors and collets. The ease with which face milling cutters are removed and replaced is particularly noteworthy—simply place cutter on table, lower spindle until nose enters cutter, as shown in the illustration and tighten drawing-in bolt. There are no plates, screws or loose parts used and when arbor, collet or cutter is in place it is essentially as firm as though a part of the spindle itself. This is one of the many outstanding features of Brown & Sharpe Milling Machines. For further information send for our Milling Machine Book.

Brown & Sharpe Mfg. Co.
Providence, R. I.,
U. S. A.

Sharpe Spindle Machines



Federated American Engineering Societies

As referred to in the July number of MACHINERY, an organization has been formed for the purpose of representing the entire engineering profession of the United States, the object of this organization being to provide means for the consideration of matters of common concern to engineers, as well as of matters of public welfare in which the engineering profession is interested. The organization will also furnish means whereby united action may be taken on public questions where the service of the engineer may prove of value. It is not intended that this organization shall in any way replace the present engineering societies, nor is it intended that engineers individually shall become members of the Federated Engineering Societies; but on the other hand, members in this organization are the societies themselves.

Fundamental Principles of Organization

Delegates representing sixty-one national and local engineering and technical societies from all parts of the United States attended the conference held in Washington, D. C., June 3 and 4 for the purpose of creating an affiliation of engineering societies to be known as the Federated American Engineering Societies. Among the societies represented were the leading national engineering bodies, such as the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, and many others.

The management of the new organization consists of a body known as the American Engineering Council, which acts through an executive board created by the council. Each member-society is entitled to one representative on the council for a membership of from 100 to 1000 inclusive, and to one additional representative for every additional 1000 members or major fraction thereof; but it is provided that no organization can have more than twenty members on the council.

The first meeting of the American Engineering Council, the governing body of the Federated American Engineering Societies, will be held at the New Willard Hotel, Washing, D. C., November 18 to 20. All engineering societies not yet members of the new organization are invited to join and to send representatives to the meeting of the council. The organization of the Federated American Engineering Societies is considered the most important step taken by the engineering profession since the formation of the large national engineering societies. The potential power for valuable civic service that the new organization will have is beyond question, and it deserves the support of all engineering societies, national or local, throughout the United States.

First Meeting of the American Engineering Council

The first meeting of the American Engineering Council of the Federated American Engineering Societies will be held at the New Willard Hotel, Washington, D. C., November 18 to 20. A complete program has been outlined, beginning with registration at 8:30 A. M. of the first day, November 18, followed at 10 A. M. by the opening session. At 2 P. M. an address will be made by J. Parke Channing of New York City on the "Engineering Council." This address will be followed by a discussion of the field of activity for the Federated American Engineering Societies.

Friday, November 19, the morning session beginning at 9 A. M., will be a business session devoted mainly to reports of committees and election of officers; an afternoon session will also be held, devoted mainly to reports. At the evening session at 8:30 P. M. there will be an address by Herbert C. Hoover, president of the American Institute of Mining and Metallurgical Engineers, after which there will be an informal reception and smoker. Saturday morning, November 20, there will be an organization meeting of the executive board of the Engineering Council.

Field of Activity of the Federated American Engineering Societies

At least 90 per cent of the money spent by the federal, state, and municipal branches of the Government is spent in one way or another for engineering work—for work that is or should be directed and carried out by engineers. The war made it clearer than ever before that our security and independence rests primarily upon the capacity of the engineering profession. Statesmen and military men alike were helpless without the aid of the engineer to furnish the means wherewith the war could be prosecuted; but the services of the engineer in time of peace can be made even more important than in time of war. It is the purpose of the Federated Engineering Societies to use the power that it derives from representing over 100,000 engineers—and ultimately probably 200,000 such men—for the service of the community, state, and nation in public affairs, whenever engineering experience and technical knowledge are involved. The engineer has been too much in the background. The time will come when he will take a leading part in the affairs of the nation, and it is to further this end that the Federated American Engineering Societies has been formed.

With an advance and development of our civilization, which may well be termed an engineering civilization as compared with the civilizations of the past, there will be an increasing number of questions arising in which the opinions of the engineering profession will be of fundamental value to the welfare of the nation. The new organization will speak for a group of men who by reason of special training and knowledge represent a high order of organizing ability and intelligence, and who individually and collectively are capable of materially aiding the solution of many of the great problems that are facing the nation as a result of disorganized conditions due to the world war. It is therefore an unusually appropriate time for the engineering societies to join at this moment in a common organization; and it is likely that as the years pass, it will become evident that if the nation avails itself more regularly of the services of engineers, it can accomplish in peace times as remarkable results as were produced in time of stress during the war.

Invitations have been issued to all engineering and technical societies to join in the federation, and those societies who have not yet taken action are urged to lend their aid in strengthening the new organization by making it truly representative of all local as well as national engineering bodies.

* * *

The International Harvester Co. has conducted an investigation in one of its plants in an endeavor to find the causes for labor turnover. It was found that much dissatisfaction among new employes was due to the practice of the older workers of discouraging the new men with whom they came in contact. The number of men leaving decreased greatly after precautions had been taken to prevent this.

JAMES HARTNESS NEXT GOVERNOR OF VERMONT

James Hartness, president of the Jones & Lamson Machine Co., Springfield, Vt., received the Republican nomination for governor of Vermont in the primary elections held September 14, running far ahead of the other three contestants. In Vermont the Republican nomination for the governorship is equivalent to election. The platform on which Mr. Hartness appealed to the electors of the state was a constructive and progressive one. It advocated such measures as would develop the industrial resources of the state, and thereby insure the prosperity of the entire population. Two of his opponents were seasoned politicians, and Mr. Hartness' victory at the polls is therefore a distinct tribute to the man. Efforts were made to discredit his industrial platform with the farmers, but the straightforward statements made by Mr. Hartness convinced them that industrial prosperity means prosperity for those engaged in agricultural pursuits as well.

Mr. Hartness will bring a new set of ideas with him into the political atmosphere of Vermont. An unusually clear thinker, and a man of straightforward and honest opinions, he will apply the methods of the engineer rather than those of the politician to the affairs of the state. Doubtless he will meet much opposition from old-line politicians; but, the same indomitable will which insured his great success in the industrial field, will enable him to put into operation the progressive ideas incorporated in his platform.

Mr. Hartness has been equally successful as a business man and as an engineer, having also made a name for himself in the field of science—an unusual combination of ability. If more men of this type were selected by the people for public office, our state and national governments would be administered on business instead of political lines. Mr. Hartness will have the best wishes not only of the whole machine tool industry, but also of the mechanical engineering world in which he is well known, having served in many capacities in the American Society of Mechanical Engineers, and as its president in 1914. It is safe to predict that the record of Mr. Hartness as governor of Vermont will be as notable as his record as engineer, inventor, manufacturer, scientist, and business man.

PERSONALS

JACK ALDEN has been made foreman of the recently enlarged steel rule die-making department of M. Freedman & Bro., 78 Duane St., New York City.

ALPHONSE A. ADLER has opened an office as consulting engineer at 9 Murray St., New York City, with machine, power, and industrial plant design and research as his specialties.

W. L. CHANDLER of the Dodge Sales & Engineering Co., Mishawaka, Ind., is a candidate for the presidency of the National Association of Purchasing Agents, the election for which will be held on October 12.

C. H. SMITH, formerly of the sales department of the R. D. Nuttall Co., Pittsburg, Pa., is now associated with the Allegheny Gear Works, Chateau and Page Sts., Pittsburg, Pa., in the capacity of sales manager.

J. H. KREIDLER, for several years an executive in various automobile plants in the Detroit locality, has joined the sales organization of the J. R. Stone Tool & Supply Co., Detroit, Mich., manufacturer of machine tools and accessories.

C. E. NEUBERT, assistant district manager of the Warner & Swasey Co.'s Chicago office, has been appointed district manager of the company's Buffalo office located in the Iroquois Building, to succeed W. E. Marshall, former manager, who recently died.

R. W. THOMAS has become affiliated with the McCrosky Tool Corporation, Meadville, Pa., in the capacity of publicity manager. Mr. Thomas is a graduate of Harvard University, where he studied the psychology of advertising, and was for some time professor of English in De Pauw University.

JULIUS JANES, formerly president of the Standard Steel Castings Co., Cleveland, Ohio, has recently made an arrangement with the Farrell-Cheek Steel Foundry Co., of Sandusky, Ohio, according to which he will be the sales representative of this organization in Cleveland and Cuyahoga County.

R. T. CLOYES for the last four years with the Lees-Bradner Co., Cleveland, Ohio, two years as sales manager and the last two years as production manager, has left this company to engage in the gear-cutting and thread milling business. The company that he has formed for this purpose is the Cloyes Gear Works, 7708 Quincy Ave., Cleveland, Ohio.

C. B. COLE, formerly manager of the Chicago store of the Union Twist Drill Co., and previous to that chief tool inspector of the Wright-Martin Aircraft Corporation, Long Island City, N. Y., and New Brunswick, N. J., has become associated with the W. L. Romaine Machinery Co., of Milwaukee, Wis., in the capacity of vice-president and sales manager.

EDWARD GROSSMAN, formerly of the Jasper Bayne Co., of New York City, is now associated with the T. P. Walls Tool & Supply Co., 25 Leonard St., New York City, in the capacity of sales manager. It is believed that Mr. Grossman's experience will materially add to the service that the company renders in the line of machine shop, mill, and factory supplies.

F. P. JENKINS, for some years with the Brown & Sharpe Mfg. Co., Providence, R. I., and more recently with the Screw Machine Products Corporation of the same city, where he has had charge of tool work including designing, estimating, and supervising, has become superintendent of the Advance Tool Co., of Cincinnati, Ohio, manufacturer of reamers, cutters, jigs, fixtures, etc.

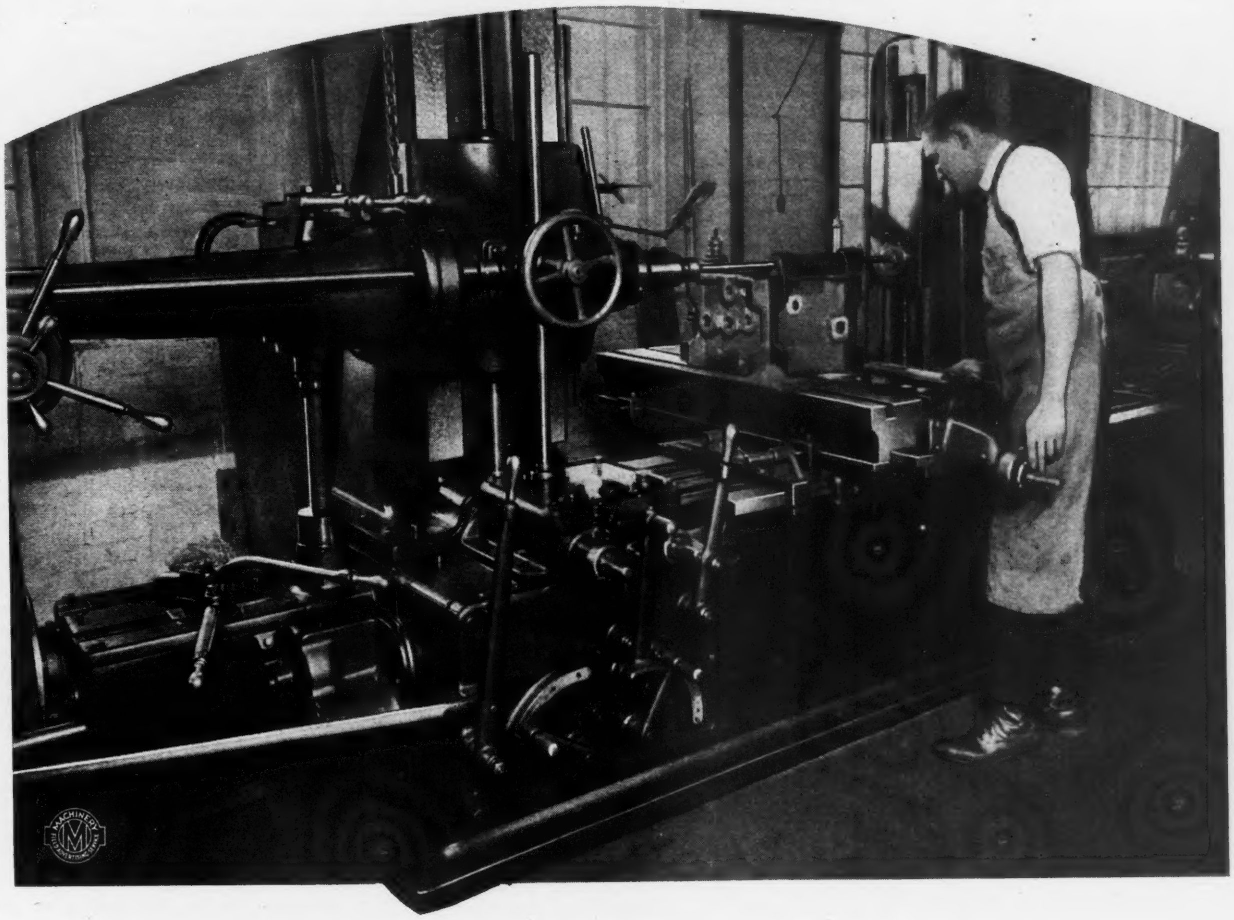
GEORGE T. AITKEN, for the last year sales manager of the Frontier Chuck & Tool Co., Buffalo, N. Y., and previous to that manager of sales in the Buffalo district for the Syracuse Supply Co., is now manager of sales in the Buffalo district for the Reed-Prentice Co., Becker Milling Machine Co., and the Whitcomb-Blaisdell Machine Tool Co., with offices in the Associated Service Bldg., 256 Main St., Buffalo, N. Y.

A. B. WAY, until recently secretary and general manager of the Bridgeport Chain Co., Bridgeport, Conn., has become district sales manager for New England, with headquarters at 150-152 Chamber St., New York City, for the Chain Products Co. of Cleveland, Ohio. For many years prior to his becoming identified with the chain industry, Mr. Way was affiliated with various New England manufacturing enterprises.

DR. E. F. NORTHRUP has resigned from his professorship at the Princeton University in order to devote his entire time to his work with the Ajax Electrothermic Corporation of Trenton, N. J., manufacturers of the Ajax-Northrup high-frequency induction furnaces. Dr. Northrup has recently been elected vice-president of this company and is now engaged in development work on a brass-melting furnace of the Ajax-Northrup type.

CHARLES WHITING BAKER, for many years editor-in-chief of *Engineering News*, and since 1917 consulting editor of *Engineering News-Record*, has retired from engineering journalism with which he has been so long identified, and has established the Engineering Business Exchange at Hudson Terminal Building, 30 Church St., Room 347, New York City, an agency the purpose of which is to bring together those desiring to sell any sound engineering or technical business—manufacturing, constructing, selling, or professional—and those seeking opportunity to purchase.

L. L. MYERS has been appointed general western sales manager of the Burke Electric Co., Erie, Pa. Mr. Myers' headquarters will continue to be in the Illuminating Building, Cleveland, Ohio, where he has been located in the capacity of sales representative for the Burke Electric Co. in



Pratt & Whitney's Boring Machine Equipment Consists Principally of

LUCAS "PRECISION"

Boring, Milling and Drilling Machines

The accompanying photo, which was taken in the tool department of the P. & W. plant, shows a Lucas "Precision" Boring Machine engaged in locating and boring 21 holes, from 9/16″ to 2¼″ diameter, in a box drill jig. Distances from center to center, in this instance, are held within 0.001″ limits; but when necessary a skilled operator makes this machine perform this same class of operation within limits of 0.0002″.

There are seven of these machines in a row in the P. & W. toolroom—all devoted exclusively to manufacturing tools and jigs. Another row in the manufacturing department is an important factor in obtaining the accuracy for which P. & W. tools have long been famous.

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

the Cleveland territory for several years. L. B. RITCHIE has been appointed general eastern sales manager, with headquarters at 30 Church St., New York City, where he has been sales representative for the New York territory of the company for some time. The direction of eastern and western sales management was formerly centered at Erie under H. A. BROWN, who is no longer associated with the company. The plan of having separate sales managers for the eastern and western territories has become advisable on account of the growth of the company's business, and it is felt that in this way it will be possible to give more efficient service to the customers.

OBITUARIES

JULIUS C. HINZ, president and general manager of the Bellevue Furnace Co., Detroit, Mich., died at the St. Bartholomew's Hospital, New York City, July 23, at the age of forty-eight years. Mr. Hinz established the Bellevue Furnace Co. eleven years ago. He was previously engaged in the painted china business, and designed many furnaces for this kind of work, and was considered an expert in furnace design and construction.

COMING EVENTS

October 4-9—Convention and exhibit of American Foundrymen's Association at Columbus, Ohio.

October 6-16—Electrical exposition to be held at the Grand Central Palace, Lexington Ave. and 46th St., New York City. Communications relating to the exposition may be directed to the Electrical Show Co., 130 E. 15th St., New York City.

October 11-13 — Annual convention of the National Association of Purchasing Agents at Chicago, Ill.; headquarters, Congress Hotel. Secretary, L. F. Boffey, 19 Park Place, New York City.

December 2-3—Nineteenth annual convention of the National Machine Tool Builders' Association in New York City; headquarters, Hotel Astor. General Manager, Charles E. Hildreth, Worcester, Mass.

December 7-10—Annual meeting of the American Society of Mechanical Engineers at 29 W. 39th St. New York City.

SOCIETIES, SCHOOLS AND COLLEGES

University of Utah, Salt Lake City, Utah. Catalogue containing calendar and announcements for 1920-1921, outline of courses of studies, list of students, etc.

California Polytechnic School, San Luis Obispo, Cal. Bulletin of information for the year 1920-1921, relating to the courses offered and the organization and methods of instruction.

BOOKS AND PAMPHLETS

Naval Consulting Board of the United States. By Lloyd M. Scott. 288 pages, 6 by 9 inches. Published by the Government Printing office, Washington, D. C.

A review of the work of the Board and of the problems handled by it.

Operation and Care of Vehicle-type Batteries. 94 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 92 of the Bureau of Standards. Price, 30 cents.

Saybolt Viscosity of Blends. By Winslow H. Herschel. 21 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 164 of the Bureau of Standards. Price, 5 cents.

House Wiring. By Thomas W. Poppe. 208 pages, 4 by 6 inches; 160 illustrations. Published by Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $1.00.

This is the fourth revised and enlarged edition of a treatise intended primarily for those who are desirous of obtaining a practical knowledge of the installation of electric lighting and power systems. It describes and illustrates methods of installing electric light and power wiring, bell wiring, and burglar alarm wiring. This edition also contains additional chapters on telephone wiring, wiring in concrete construction, conduit bending, and motor wiring.

Advertising the Technical Product. By Clifford Alexander Sloan and James David Mooney. 365 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $5.

This volume discusses the principal factors underlying the advertising of technical products, though it is conceded that the subject could not be entirely covered in a book of this size. The authors have pointed out by concrete examples what are considered to be good and bad points in modern advertising. The material is applicable to all advertising, though it is written with especial reference to the advertising of technical products. A brief sketch of the development of technical advertising is given, and examples of early advertisements are reproduced which indicate the great change that has taken place in the character of advertising in recent days. The question of returns is considered, as well as advertising appropriations, and the planning and carrying out of advertising campaigns. The various advertising mediums are discussed, including technical and trade magazines, popular magazines and newspapers, direct mail advertising, catalogues, and house organs. There are chapters on advertising display and on the writing of copy. The appendix of the book presents reproductions of a number of advertisements, picked at random from the technical, trade, and popular magazines, together with criticisms of each made by a sales manager, an advertising manager, a sales engineer, and a purchasing engineer. The book is divided into five parts, treating, respectively, of the General Problem and its Economic Elements; the Instruments Available for Advertising the Technical Product; Technical Advertisements; Advertising Organizations; and Appendix. The treatment of the subjects will best be understood by a list of the chapter headings: Introduction; Advertising the Technical Product; the Economic Problem; the Product; the Market for the Product; Advertising the Product to the Market; the Advertising Appropriation; the Campaign; the Technical and Trade Magazines; the Popular Magazines and Newspapers; Direct Mail Advertising; Prospectuses, Bulletins, Catalogues; House Organs; Educational Work; Advertising Ammunition; Technical Advertising Display; Technical Advertising Copy; the Advertising Department; Advertising Counsel; the Publisher's Service Department; Dealer Corporation; Criticisms of Advertisements; Bibliography; and Index.

NEW CATALOGUES AND CIRCULARS

Nickle Engineering Works, Saginaw, Mich. Bulletin 3-D descriptive of a new type of can-filling machine, adapted for the packaging of dry materials.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular advertising Cleveland punches, dies, rivet sets, chisel blanks, markers, barrel pins, drift pins, etc.

Gisholt Machine Co., 9 S. Baldwin St., Madison, Wis. Circular advertising the "Periodograph," for recording the exact amount of time each workman spends on every job.

Lees-Bradner Co., 6212 Carnegie Ave., Cleveland, Ohio. Circular advertising the Lees-Bradner gear-hobbing machine, which employs hobs having straight-sided rack teeth for generating involute gear teeth.

Hyatt Roller Bearing Co., Sixth Ave. and 41st St., New York City. Circular advertising Hyatt roller bearings, illustrating their application in motor cars, tractors, traveling cranes, trucks, conveyors, etc.

Peter A. Frasse & Co., Inc., 417 Canal St., New York City. Stock list for September, 1920, of cold-drawn seamless steel tubing in round sizes, square sizes, and odd sizes. A list of short lengths of tubing is also given.

Hobart Bros. Co., Troy, Ohio. Bulletin 91, illustrating and describing the HB ball-bearing motor grinder for grinding castings, sharpening tools, buffing tires, and other uses in machine shops, repair shops, garages, etc.

General Electric Co., Schenectady, N. Y. Bulletin No. 40017A describing small, direct-current generators and exciters, Type ML. Bulletin No. 60011 describing engine-driven continuous current generators of the commutating pole type.

Davis-Bournonville Co., Jersey City, N. J. Circular containing instructions for setting and operating the Davis-Bournonville radiagraph—a portable machine for cutting to straight and curved lines with an oxy-acetylene cutting torch.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. Circular descriptive of the "Thor" universal electric drills, which are made in six sizes with capacities for drilling 1/4-, 5/16-, 3/8-, 1/2- and 9/16-inch holes, respectively.

Cleveland Automatic Machine Co., Cleveland, Ohio. Booklet containing general directions for setting up and operating Cleveland Model A motor-driven automatics. The book is intended for the use of operators and is illustrated with halftone engravings which make the instructions very clear.

Expansion Boring Tool Co., Detroit, Mich. Circular illustrating and describing expansion boring tools and reamers, by means of which cutters are under positive screw control and have a practical micrometer adjustment. The bulletin also gives a table of standard sizes of expansion boring-bars and cutters.

Golden Co., 405 Lexington Ave., New York City. Catalogue 261, describing the plain, limit, and standard gages made by the Societe Genevoise d' Instruments de Physique of Geneva, Switzerland. The book also gives tables and diagrams of fits and tolerances for various kinds of work in interchangeable manufacture.

Norton Co., Worcester, Mass. Bulletin entitled "Snagging" treating of the selection, care, and use of snagging wheels of different grains and grades for grinding various materials. The bulletin also gives information on grinding costs and the mounting of wheels, as well as price lists of Norton alundum or crystolon wheels.

Pennsylvania Forge Co., Bridesburg, Philadelphia, Pa. Catalogue No. 23, descriptive of forged and pressed steel die-blocks made from acid open-hearth steel. The catalogue is illustrated with views from the Pennsylvania Forge Co.'s plant and contains descriptions of die-blocks made from different grades of carbon and alloy steels.

Metalwood Mfg. Co., Detroit, Mich. Circular giving operating instructions and specifications for the Metalwood No. 300 hand-operated arbor press, which has a rated working capacity of 15 tons at 2500 pounds. Circular B-38, containing dimensions, prices, and other data for drop-forged steel hydraulic fittings and seamless cold-drawn steel hydraulic tubing.

Van Keuren Co., 362 Cambridge St., Allston Station, Boston, Mass. Circular G-1, descriptive of Van Keuren combination reference gages, which are cylindrical shaped blocks with highly accurate flat measuring surfaces adapted for reference purposes in checking tools and shop gages. Reference is also made to the use of "OK-VK" micro-gages for production requirements.

Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Bulletin BF entitled "A New Method of Recording Blast Furnace Temperatures," illustrating and describing how blast furnace temperatures are recorded by means of the potentiometer. Actual charts are reproduced showing exactly how the records obtained from the potentiometer appear in practice.

Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Circular entitled "Picking Up and Putting Down with a Shepard Monorail Hoist." The circular explains the advantages to be derived from the use of floor-controlled electric monorail hoists for handling heavy work in factories engaged in high-speed production, and shows illustrations of hoists engaged on this class of work.

Boston Scale & Machine Co., 100 Ruggles St., Boston, Mass. Circular describing the 12-inch rotary grinder built by the company. The aim in designing this grinder has been to produce a tool capable of maximum output coupled with convenience of operation and low maintenance cost. The circular gives a complete description of the main features of the machine, and also shows front and rear views.

Norton Co., Worcester, Mass. Circular showing front and rear views, and describing the characteristic features, equipment, etc., of the 12- by 36-inch Type L Norton multipurpose grinding machine. Circular showing front and rear views, describing the characteristic features, and giving specifications covering capacity, dimensions, speeds, etc., of the 10- by 72-inch Type B Norton cylindrical grinding machine.

Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. Bulletin No. 54 describing continuous milling machines, showing illustrations of the use and application of the machines in continuous milling, and giving specifications and table of standard dimensions. Bulletin No. 55 on model V-2 continuous milling machines with specifications, table of standard dimensions, and illustrations of application.

Royal Manufacturing Co., Rahway, N. J. Booklet entitled "Clean Clean Thru," containing interesting information relating to cotton waste. The purpose of the book is to familiarize the mechanical trades with a few of the intricacies associated with cotton waste in the making and in the buying. The booklet is illustrated with halftone engravings showing clearly step by step the methods by which cotton waste is manufactured in the company's plant.

Oesterlein Machine Co., Cincinnati, Ohio. Bulletin B, illustrating and describing the mechanical features of the 40-inch Ohio tilted rotary milling machine, which may be used either for continuous or station milling, though the latter is its principal field of application. A number of fixtures of the hand-clamping and compressed air-operating type, used for station milling, are illustrated, and in each case data are given covering the speeds and feeds employed, and the rate of output obtained.

ARE YOU PARTICULAR?

If so, you certainly have use for the

H. S. & CO. PORTABLE MACHINIST TOOL CASE

It is the most practical case made. The drawers are so arranged that every available inch can be utilized, and the tools so distributed that each one can quickly and easily be found without first handling a number of other tools which have hurriedly been placed on top of the one wanted. With the exception of the bottoms and sides of drawers, cases are made throughout of thoroughly kiln-dried solid (not veneered) Oak or Mahogany, which will not warp nor twist, handsomely polished and finished; the corners are dovetailed and the *workmanship is of the very best.*

Showing Case Open and Drawers Exposed

Showing Case Closed and Locked

The trimmings are of polished brass. Each case has a brass spring lock with two flat steel keys and a comfortable leather handle for convenience in carrying.

The drawers run on hardwood slides, have brass polished knobs, and bottoms are lined with genuine felt.

Machinists will find the little mirror which is placed on the inside of the case a very handy and convenient addition.

Outside Dimensions When Closed, 15⅝ Inches Long, 8¼ Inches Deep, 11 Inches High

Inside Dimensions of Drawers		Inside Dimensions of Drawers	
First	6½" Long, 6" Deep, ¾" High	Fifth	6½" Long, 6" Deep, 15/16" High
Second	6½" Long, 6" Deep, 2¼" High	Sixth	14⅛" Long, 6" Deep, ½" High
Third	6½" Long, 6" Deep, ¾" High	Seventh	14⅛" Long, 6" Deep, 1" High
Fourth	6½" Long, 6" Deep, 1" High	Eighth	14⅛" Long, 6" Deep, 3¼" High

Weight, Packed for Shipment, 20 Lbs. Not Packed, 15 Lbs.

No. 125—Mahogany.................................. }
No. 120—Oak.. } $15.50 Each F.O.B. New York City

HAMMACHER, SCHLEMMER & CO.

HARDWARE, TOOLS AND FACTORY SUPPLIES

4th Avenue and 13th Street NEW YORK (Since 1848)

Chicago Belting Co., 127 N. Green St., Chicago, Ill. Booklet entitled "Practical Information on the Use and Care of Leather Belting," containing many valuable pointers relating to the care of leather belting in order to insure satisfactory service and long life; rules for calculating horsepower, width and speed of leather belting; horsepower table; rules for calculating length of belting; size and speed of pulleys; methods of belt lacing; and other information valuable to belt users.

Anderson Bros. Mfg. Co., Rockford, Ill. Catalogue illustrating and describing the construction and use of the Anderson pneumatic scraper which may be applied to all classes of scraping operations in machine construction. The catalogue also illustrates and describes the turntables furnished as regular equipment with the stationary and small portable scrapers when desired. The halftone illustrations in this catalogue show clearly the many different applications of the pneumatic scraper.

Driver-Harris Co., Harrison, N. J. Bulletin N-21, entitled "Nichrome," illustrating and describing modern heat-treating containers, including carbonizing boxes and pots, lead tempering pots, cyanide and salt pots, tubular retorts, annealing pots, furnace muffles, pyrometer protection tubes, furnace floors, parts for continuous operation furnaces, dipping baskets, and parts for glass making machinery. The bulletin calls attention to the advantages gained by the use of cast nichrome containers, and gives information relating to nichrome and its uses, together with a list of the stock patterns of boxes and containers for heat-treatment made from this alloy.

Sprague Electric Works of General Electric Co., 527 W. 34th St., New York City. Circular describing combination conduit bodies for exposed wiring, known as "Spraguelets." Circular entitled "The Universal Key," which comprises a quick cross-reference for matching any standard wiring device to any desired box and cover. The key gives the catalogue number of the device to be used and a symbol designating the proper box and cover for the various devices. These symbols are arranged under the names of different manufacturers of wiring devices, which are classified alphabetically. The boxes corresponding to the symbols are shown on the wings of the pamphlet.

General Electric Co., Schenectady, N. Y. Bulletin 41311, treating of synchronous condensers and their use for power-factor correction and power-factor control. Bulletin 48704 A, discussing G-E insulating compounds, including varnishes, japans, oils, stickers and shellacs, paints, and sealing compounds. Bulletin 48715, dealing with G-E insulating fabrics, including treated cloths, fibers and papers, insulating tapes, varnished cloth tapes, cotton tapes, asbestos tapes, friction and splicing tapes, cords and twines, and sleevings. The bulletin contains an especially prepared list of standard materials with a brief description of each, designed to assist customers in selecting the material they need.

Van Dorn Electric Tool Co., Cleveland, Ohio. Bulletin describing improved heavy-duty ball bearing electric grinders and buffers. The bulletin gives general specifications of the pedestal and bench grinders built by the company, illustrates graphically the various improvements that have been made in these machines, and shows by large halftone illustrations the exact design and construction of the different types. Specifications are given for one-horsepower floor grinder for two guarded wheels, one-horsepower floor grinder for one guarded wheel and left-hand extension for brush, one-horsepower floor type machine with buffer or grinder extension on both ends, one-horsepower bench grinder for two guarded wheels, and one-horsepower aerial grinder.

Driver-Harris Co., Harrison, N. J. Booklet entitled "Case Carbonizing," giving a complete outline of the methods used in case carbonizing or casehardening. The book is divided into eight chapters, as follows: Case Carbonizing; Cyanide Hardening; Gas Hardening; Lead Tempering and Hardening; Carbonizing Containers; Nichrome—Commercial and Technical Data; Cast Nichrome Containers; and Commercial Methods for Using Nichrome Castings. It also contains an appendix devoted to carbonizing boxes and dealing particularly with the nichrome boxes made by the Driver-Harris Co. These boxes are now made in a wide variety of standard stock patterns and sizes, the dimensions of which are given in the appendix together with drawings of the boxes and containers.

Joseph T. Ryerson & Son, Chicago, Ill. Bulletin entitled "Machinery Quarterly." This is the first of a series of bulletins which will be issued quarterly as the machinery and tool section of the Ryerson Steel Service Book. This publication is not intended as a complete machinery catalogue, but places before machinery users condensed descriptive matter covering the line of equipment manufactured and handled by Joseph T. Ryerson & Son. The book contains sixty-four pages, and illustrates and describes a great variety of lathes, planers, shapers, drilling machines, milling machines, grinding machines, drill grinders, power hammers, sawing and cutting-off machinery, power presses, punching and shearing machinery, bending rolls, pipe cutting machinery, welding and cutting machinery and outfits, etc.

Edwin Harrington, Son & Co., Inc., Philadelphia, Pa. Bulletins No. 76, on No. 40-A multiple-spindle drilling machine; No. 77, on No. 15, 16 and 17 multiple drilling machines; No. 78, on No. 15, 16 and 17 multiple drilling machines with special frames; No. 79, on No. 41-A, B and C multiple-spindle drilling machines; No. 80, on No. 51-A, B and C multiple-spindle drilling machines; No. 81, on No. 51-D and E multiple-spindle drilling machines; No. 82, on No. 61-B and C multiple-spindle drilling machines; No. 83, on No. 62-F and G multiple-spindle drilling machines; No. 84, on No. 62-A, 63-A and 63-B multiple-spindle drilling machines; No. 85, on No. 72-A and 72-B multiple-spindle drilling machines; No. 86, on horizontal multiple-spindle drilling machines; No. 87, on rotary top tables; No. 88, on No. 130 horizontal drilling machines; and No. 89, on No. 32 radial-rail drilling machine.

TRADE NOTES

Toledo Milling Machine Co., Toledo, Ohio, is now in full operation in its new Summit Ave. factory, producing high-duty vertical milling machines.

Shaw Mfg. Co., Lynn, Mass., would like to receive catalogues of automatic machinery, turret lathes, drilling machines, and machinery suitable for manufacturing small metal products.

Stewart Mfg. Corporation, 4500 Fullerton Ave., Chicago, Ill., manufacturer of bronze-back bearings and die-castings, has opened a branch office in New York City, at 30 Church St., in charge of Louis Ruprecht.

Wade-American Tool Co., Waltham, Mass., manufacturer of precision bench machines, tools, gages, dies, and fixtures, announces that its office and works are now located in its new building at 49-59 River St.

A/B Machinery O/Y, Abo, Finland, distributors of machinery, machine tools, and supplies, announce that they have closed their American office, and that the affairs of the company hereafter will be handled from the home office in Finland.

Boynton & Raleigh, 166 Rosewood Terrace, Rochester, N. Y., is a new firm that has been formed by S. E. Boynton and R. E. Raleigh for the designing of special machinery and tools, and for the planning and organizing of manufacturing plants and their equipment.

Bellevue Industrial Furnace Co., Detroit, Mich., manufacturer of steel-treating furnaces for oil and gas, announces that the present officers of the company are as follows: President, B. F. Drakenfeld, Jr.; vice-president, Walter E. Hinz; secretary and treasurer, C. A. Norman.

Lehmann Machine Co., 514 S. Broadway, St. Louis, Mo., manufacturer of engine lathes, is now located in its new plant at Chateau and Grand Aves. The new shop was designed by Mr. Lehmann and affords 40,000 square feet of floor space. The offices will be located on the second floor.

Isbecque, Todd & Co., 36, rue Otlet, Brussels, Belgium, will in the future be the name of the firm formerly conducted under the name of E. Isbecque & Co. There will be no change whatever in the organization, and the company will be devoted to the selling of American machinery and tools, the same as in the past.

Cloyes Gear Works, 7708 Quincy Ave., Cleveland, Ohio, has been organized by R. T. Cloyes, formerly production manager of Lees-Bradner Co., Cleveland, Ohio. The new concern will specialize in the manufacture of metal and composition gears and will also do job thread milling of all kinds, including precision lead-screws.

George G. Kuenstler, Post box 162, Riga, Latvia, formerly of Moscow, Russia, where he had an engineering office, announces that he has opened an office in Riga under the firm name of George G. Kuenstler, and expects to import machinery of all kinds for the requirements of Latvia and later for the trade with Russia.

Herberts Machinery & Supply Co., Los Angeles, Cal., announces that the company's San Francisco store has just moved into its new location at 140 E. First St. The new store is housed in a two-story building with basement, having approximately 2000 square feet of floor space and erected at a cost of approximately $100,000.

D. C. Oviatt & Co., 401 Garfield Bank Bldg., Cleveland, Ohio, has been organized for the purpose of dealing in used sheet-metal working presses. D. C. Oviatt, manager, was for five years sales engineer for E. W. Bliss Co., Brooklyn, N. Y., and for two years previous was connected with the sales department of Charles A. Strelinger Co., Detroit, Mich.

Simonds Mfg. Co., Fitchburg, Mass., manufacturer of saws, knives and files, announces that following out special plans for general advancement in research work, the company has just completed an addition, 40 by 50 feet, to its research laboratory connected with its steel mills at Lockport, N. Y. Additional equipment, in the form of electrical melting furnace, heating furnaces, etc., has been installed.

Henry Disston & Sons, Inc., Philadelphia, Pa., announce that they will have an exhibit of metal-cutting saws and files of all kinds in building No. 5 at the exhibit of the American Foundrymen's Association at Columbus, Ohio, October 4-9. Power hacksaws and sectional interlocked inserted tooth circular milling saws will be shown in operation. Metal slitting saws, hacksaw blades, screw slotting saws and files will also be exhibited.

Hobart Bros. Co., Troy, Ohio, has added a line of general-purpose ball bearing electric motors to its present line of electrical specialties. The line will consist of motors of 1, 2, 3, 5, 7½, and 10 horsepower, operating on both alternating and direct current. All the motors will be equipped with ball bearings. The company states that the production of electric motors will in no way interfere with its other manufacturing interests.

Pangborn Corporation, Hagerstown, Md., announces that it will have a varied line of equipment on exhibit at the American Foundrymen's Association convention and exhibit at Columbus, Ohio, October 4-9. Among the exhibits of the Pangborn Corporation will be a complete line of sand-blast equipment adaptable for metal cleaning from small parts up to heavy castings; several types of sand-blast barrels; automatic tables; hygienic rotative table cabinets; and auxiliaries for sand-blast equipment.

Fawcus Machine Co., Pittsburg, Pa., manufacturer of herringbone, spur, and worm gears, reduction gear drives, rolling mill machinery, and special heavy machinery, has consolidated all of its departments in its new office building at 2818 Smallman St., adjoining the Pittsburg Works, in order to facilitate the handling of its enlarged business. A downtown office will be maintained in suite 1501, Peoples' Savings Bank Bldg., where its allied company, the Schaffer Engineering & Equipment Co., is located.

Seneca Falls Mfg. Co., 381 Fall St., Seneca Falls, N. Y., manufacturer of lathes, has taken over the O. R. Adams Mfg. Co., Inc., of Rochester, N. Y. The Seneca Falls Mfg. Co. will continue to manufacture the Adams short-cut lathe in addition to its regular lines. Ogden R. Adams will not be connected with the short-cut lathe business in the future, but will give his entire time and interest to his machine tool business at the St. Paul St. store in Rochester. He will, however, handle the Adams short-cut lathe exclusively in the local territory.

Manufacturer's Steel Exchange Co., Naperville, Ill., announces that it is endeavoring to serve manufacturers by acting as a medium for the exchange of structural steel, bar and sheet steel, and bolts, machine screws, and rivets. The company sends out a printed form on which prospective clients may list both their requirements and their surplus stock of these products. Semi-monthly stock lists are made out from these forms. Thus manufacturers can secure material for their needs from those who carry a surplus.

Peerless Surfacing Machine Co., Inc., formerly of Newark, N. J., has been reorganized and is now located at Troy, N. Y. The company manufactures the Peerless belt sanding machines for grinding and polishing a wide variety of materials requiring a smooth flat surface, as well as the Peerless surfacing machines for beveling, squaring or grinding both angles and plane surfaces. The new location will enable the company to produce these machines on a larger scale. E. J. Bein, the inventor of these machines, will remain with the new company as chief engineer.

Acklin Stamping Co., 1657 Dorr St., Toledo, Ohio, announces that plans have been made to build a large fireproof factory to house an enlarged plant which will employ 750 men. The new factory will be erected on Nebraska Ave., near the Lake Shore Crossing, Toledo, Ohio, and the capitalization of the concern is to be increased from $50,000 to $500,000. The lay-out of the buildings includes a warehouse with a capacity of 50,000 tons of steel, punch press departments, annealing furnaces, nickel-plating and galvanizing plants, and electric welding and tool-making departments.

Carroll Foundry & Machine Tool Co., Bucyrus, Ohio, has purchased the business of the Carroll Foundry & Machine Co., for many years engaged in the production of heavy gray iron castings and heavy machine work, and also of the Lambert Machine & Engineering Co., Cleveland, O., builder of the Lambert horizontal boring, milling, and drilling machine. The company has complete equipment and organization for manufacturing the Lambert machine on a large scale. The officers of the new company are O. J. Ashman, Cleveland, president; C. F. Michael, Bucyrus, vice-president; W. E. Matthew, Cleveland, secretary; R. B. Washburn, Cleveland, treasurer; and David Lambert, Cleveland, general manager of the machine tool division.

Reed-Prentice Co., Becker Milling Machine Co., and Whitcomb-Blaisdell Machine Tool Co., whose sales organizations have recently been combined, and whose main offices are located at 53 Franklin St., Boston, Mass., have published a bulletin illustrating and giving specifications for the following products: Reed-Prentice 12-, 14-, 16-, 18-, 20-, 24-, and 27-inch geared-head lathes; Reed-Prentice 12-, 14-, 16-, 18-, 20-, and 24-inch engine lathes; Reed-Prentice automatic lathes; Reed-Prentice 3-, 4-, and 5-foot radial drilling machines; Becker vertical milling machines with rotating table and cone or gear-box drive; Becker universal milling machines; Whitcomb-Blaisdell 20- by 17-, 24- by 24-, 26- by 26-, 30- by 30-, 32- by 32-, 36- by 36-, and 42- by 42-inch planers; and Whitcomb-Blaisdell engine lathes (medium pattern) 16-, 20-, 24-, and 30-inch sizes; (heavy pattern) 14-, 16-, 18-, 20-, and 24-inch sizes.